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QUARTERMASTER RESEARCH & ENGINEERING COMMAND
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SYSTEMS RESEARCH IN "MICROLOGISTICS" AND HUMAN FACTOR ASPECTS OF SMALL GROUP CAPABILITIES IN A POLAR AREA

QUARTERMASTER RESEARCH & ENGINEERING CENTER

DECEMBER 1961 NATICK, MASSACHUSETTS

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Quartermaster Research & Engineering Center
Natick, Massachusetts

QUARTERMASTER POLAR RESEARCH PROJECT
PPO-59

SYSTEMS RESEARCH

IN

"MICROLOGISTICS" AND HUMAN FACTOR ASPECTS

OF SMALL GROUP CAPABILITIES IN A POLAR AREA

A. Levin

D. R. Peryam R. Seaton

N. Morana A. Hastings, Jr.

December 1961

FOREWORD

One of the prevailing problems facing Quartermaster Corps research and development of the future is concerned with how well-balanced new man-materiel systems are to be conceived and engineered for remote areas of the earth.

This is a report which presents the first phase results on systems research based on data obtained through Quartermaster Corps research and engineering effort in establishing three remote experimental stations on the Greenland Ice Cap, approximately 700 miles from the North Pole, during July and August 1959.

The emphasis in this particular phase was directed towards investigation of the form in which Quartermaster man-materiel systems may be assembled. The degree to which objective and subjective measurements may be used to discriminate between the effectiveness of each man-materiel system as complete units was studied. In dealing with the measurement of effectiveness, logistical inputs and operational outputs were examined for each system, and the interactions between the man, his materiel, and his activity were derived on an over-all net basis.

Further studies and experiments of this type are needed. This approach unfolds new opportunities to improve understanding of the system concept and its engineering. By focusing on the interactions which human requirements and materiel design factors may have on supporting systems, a new basis for evolution of future Quartermaster Corps equipment research and development may be obtained.

ALEXANDER LEVIN
CY-59 QMC Polar Research Projects

APPROVED:

DALE H. SEILING
Scientific Director
QM Research and Engineering Command

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Brigadier General, USA
Commanding

TABLE OF CONTENTS

TABLE OF CONTENTS (cont.)

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS (cont.)

LIST OF TABLES

ABSTRACT

This report deals with the initial phase of research on systems of US Army Quartermaster equipment, supplies, and related materiel in a selected polar environment. The emphasis in this study was on investigating the form in which such systems may be assembled and what measures may be used to discriminate the effectiveness of such systems as complete units. The degree to which logistical inputs and operational outputs interact with system component design and activity of personnel was also examined.

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SYSTEMS RESEARCH IN "MICROLOGISTICS" AND HUMAN FACTOR ASPECTS OF SMALL GROUP CAPABILITIES IN A POLAR AREA

1. INTRODUCTION

1.1 GENERAL SCOPE AND PURPOSE

This report deals with the initial phase of research on systems of US Army Quartermaster equipment, supplies, and related materiel in a selected polar environment. The emphasis in this study was on investigating the form in which such systems may be assembled and what measures may be used to discriminate the effectiveness of such systems as complete units. The degree to which logistical inputs and operational outputs interact with system component design and activity of personnel was also examined.

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1.2 DEFINITION OF SYSTEM TERMS

The terms used in this study are not common to any one scientific discipline. In dealing with the interaction of terms used by several disciplines involved in this work, it was found necessary to give specific designations to the components in the study. Essential terms are defined below and will be reiterated throughout the report.

Cycle - Three 1-week task periods. There were 2 cycles in this study.

Tasks - A combination of integrated and detailed operational activities, including preparation and consumption of food, sanitation, movement, and camp erection.

Tasks Period - One calendar week, from Sunday afternoon to the following Saturday afternoon in the field, and from Saturday afternoon to Sunday afternoon in base camp.

System - An assemblage of objects united by some form of interaction or interdependence; specifically, a group of men and machines performing together to accomplish a common objective.

POMMS (Polar Micromateriel Systems) - A complete assemblage of machines or equipment, comprising 5 subsystems, i.e., (1) Clothing, (2) Shelter and Protection, (3) Heating, (4) Food, Food Service, and Sanitation, and (5) Operational Equipment.

Module - A basic unit consisting of a given number of men, in this case, 6.

Element - One member of a Module; 1 man. Six elements make up 1 Module.

Micrologistics - The logistic aspects related to the requirements of small units as distinguished from the broader phases of logistics research.

Microlog Task - An activity involving movement with all of the equipment common to the entire Module being hauled on sleds.

Microtac Task - An activity involving movement with individual loads (rucksacks) by a Module.

1.3 BACKGROUND

1.3.1 General Problems of Polar Regions.

There is probably no other part of the earth in which the capabilities of men and equipment, and planning of military operations are tested by unusual extremes of climate and terrain as they are in the polar regions in a sequence of serious operational problems which could culminate in disaster[1]. Therefore, the need for precise planning to assemble an effectively integrated system of food, fuel, shelter, clothing, and operational tools and equipment for the smallest operational unit is continuously present. Considerable effort and time must be devoted to procuring and assembling the myriad of required items and components from supply sources, because of the manner in which these items are stocked. The readiness of supply centers to respond rapidly to the operational requirement of a strategic army force has been a subject of considerable study from many viewpoints.

[1] Croft, Andrew J. Polar Exploration, A. & C. Black, London, Eng., 1947

Simplification processes have been attempted,[1] and components, parts, and subassemblies have been repeatedly discarded in favor of a single unit supply and replacement, to reduce waiting or "down" time of systems in becoming operational. The process of simplifying individual clothing and equipment has been the active concern of Quartermaster Corps research and development for many years. Various attempts have been made to reduce the multiplicity of items required for the individual soldier and units for military operation. For example, tariff sizes of clothing have been reduced, tentpole-stovepipe combinations have been tried, and a universal single combat uniform has been proposed.[2]

Despite this process of earnest simplification, the continuing adaptation of products from a changing machine and transportation technology tends to expand and multiply the complexity of the logistic process. The unrestrained development of this technology greatly expands the requirements coincidentally for improving the military capabilities in environments heretofore considered remote. The need for augmenting existing items becomes more important as contacts with the remote geographic regions increase. The simplification process then becomes reversible.

1.3.2 System Attitude and Approach

In this complex process, one of the principal problems frequently encountered is that too often the assessment for the need of new items or requirements is conceived on a part or component basis. Little effort can currently be identified with research on those parameters which are essential to the definition of the Quartermaster Corps aspects of a system design. Engineering of operational assemblages based on some measure of logistical advantage and economy is generally absent.

Operating over the Greenland Ice Cap is a logistically formidable problem. It presents a suitable field laboratory for experimenting with system components in their relation to the logistic problems of small units operating in this area. By using this approach, it is expected that the factors influencing logistics at the lowest unit level may be measured objectively; system components may be observed so that multipurpose functions can be uncovered and evaluated; and methods of reducing weight and volume of equipment carried by the individual soldier and small units may be effected.

1 Lusser, Robert. The Notorious Unreliability of Complex Equipment. September 1956

2 US Army Quartermaster Corps R&D Annual Project Reports, 1949 thru 1959

1.3.3 The Basic Task Group in the Arctic

From the earliest periods of recorded military history, and in current military doctrine, small units (squad, gun crew, wire team, etc.) have formed the basic task group in the northern latitudes.[1] Under normal operating conditions it is expected that such a unit (4 to 8 men) will work together, cook and eat together, and share the same shelter. The individuals who form these small units should be carefully selected and be compatible as a model of efficiency, enthusiasm, and high morale. These individuals grouped as a Module must be integrated with equipment systems and developed or trained to meet the requirements of the environment and predictable combat situations.

The Quartermaster Corps has long carried out research on the psychological, physiological, and biophysical parameters which influence the capability of the individual soldier and individual items of Quartermaster Corps equipment. This study offers a new opportunity to examine the more complex interaction of individual capabilities and the dynamics of group effectiveness in relation to equipment system parameters.

No matter to what degree a force may be mechanized, current doctrine states that success in northern combat depends on troops that can move dismounted across the country, covering great distances in short times.[1]

1.3.4 Preparation

In 1958, a team of Quartermaster Corps technical, engineering, and military observers visiting the US Army Polar Research and Development Center in Greenland reported on the susceptibility of mechanized operations to breakdown. Collaterally the need for integrated studies on small, dismounted group operations in the US Army Polar Research Program was also recognized and emphasized.[2]

Since the concept of the investigation involved a spectrum of many Quartermaster Corps research and development areas, a task group was organized to insure adequate representation and coordination of interests, skills, and experience. This group included the following Quartermaster Corps Research and Engineering Command personnel: Task Leader, Alexander Levin, mechanical engineer, Mechanical Engineering Division; William Goddard, technologist, Environmental Protection Research Division; Eldon Metzger, test coordinator, Textile, Clothing and Footwear Division; Elliott Snell, chemical products technologist, Chemicals & Plastics Division; Sir Hubert Wilkins,[3] geographer, Environmental Protection

1 US Govt. DA - FM 31-71, Northern Operations. 1959
2 Report on Thule, Tuto, Greenland by C. Ashline, A. Levin, et al. QMREC Travel Report, Sep 58
3 Deceased, Dec 58

Research Division; Michael Slauta, military analyst, Military Liaison Office; A. C. Rauch, food technologist, QM Food and Container Institute for the Armed Forces; and Major Carl Ashline, military representative, QM R&E Field Evaluation Agency.

1.3.5 Acknowledgments

The authors are especially indebted to Thomas E. Dee, Jr., William J. Boardman, and Earl H. Pester, who so ably assisted in collecting data. The following persons have read and commented on one or more sections within their fields of special competence: Robert L. Anstey, William B. Brierly, E. Ralph Dusek, Junius W. Millard, and Frederick Rice. Drafts of the original manuscript were distributed to the following: Austin Henschel, Bernard J. Fine, Arthur Kaplan, C. Bruce Lee, Mark E. McCormack, Eldon Metzger, Ferdinand D. Schaller, Welsh C. Whittlesey, and Robert Woodbury, who provided valuable suggestions. Among the many persons who have helped in the mechanics of typing, duplicating, and the like, appreciation is expressed to Agatha N. Harden and personnel of the Technical Services Division.

1.4 CONCEPT AND THEORY

1.4.1 Systems Concept

Systems research is generally defined in terms of the systems with which it is concerned. A system in general terms may be defined as an assemblage of objects united by some form of interaction or interdependence, and specifically a group of men and machines performing together to accomplish a common objective.[1] Systems are also bounded regions in a space-time frame which involves energy interchange among the parts which are associated in some functional relationship and within the environment boundary.[2] A system seldom operates in isolation, but is itself a component of a larger system and at the same time composed of a number of subsystems. This is the basic view of what will be considered the Quartermaster materiel system.

The system as framed in this report is conceptually illustrated in Figure 1.4-1/A. It is expressed in a way to help emphasize a mental image of the system boundaries. Within the generalized space, time, and environmental dimensions shown, three components are depicted in a variety of geometric forms, to distinguish the major interdependent bodies of system elements: i.e., the "Module" as a basic unit of a given number of men or elements; the "POMMS" as a complete assemblage

1 Tufts University Handbook of Engineering Data. Medford, Mass., Apr 55.
2 Miller, J. G. Toward a General Theory for the Behavioral Sciences. American Psychologist 10: 513-522, 1955.

of equipment; and "TASKS" as a network or combination of integrated and detailed operational activities.

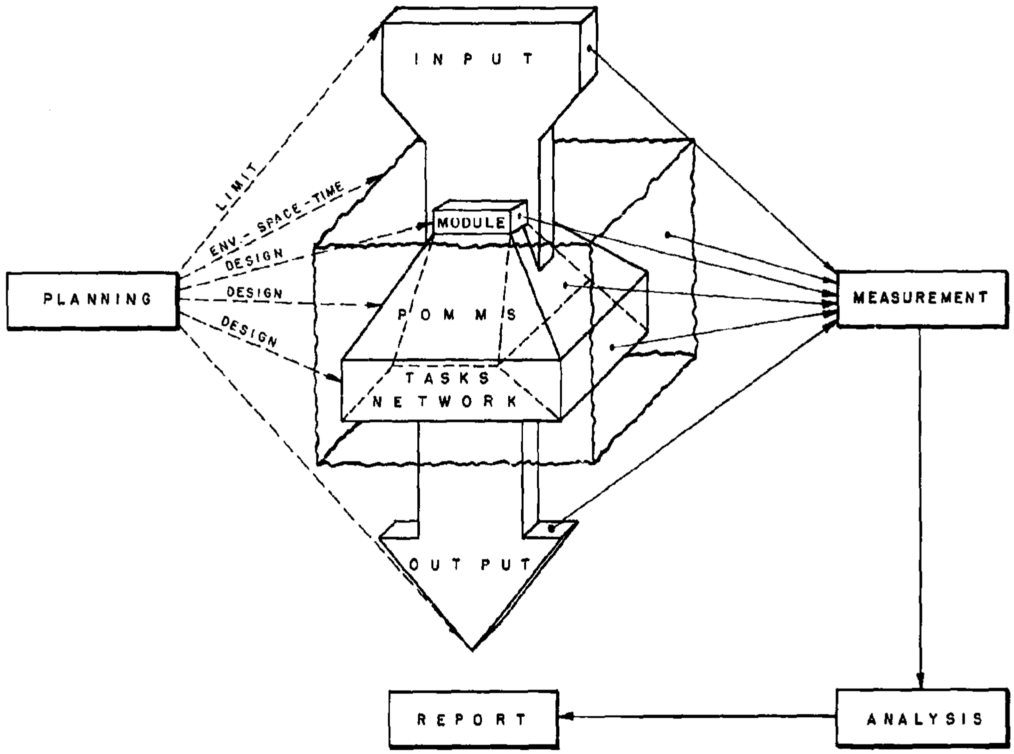

Figure 1.4-1/A - General concept of QM systems research experiment

1.4.2 System Experimental Design

For many years the system research approach has been a valuable tool for simplifying industrial and military processes as technology has changed. From this have come systems of equipment which are effective in terms of cost, reliable in terms of maintenance and, more important, capable of improved operational and tactical performance at a reduced cost to supporting systems.[1]

[1] Morse, P. M. and Kimball, G. E. Methods of Operations Research (1956), John Wiley & Sons, N. Y.

The Module enters the system action in two distinct ways. It has the function of decision in the use of the system, and in this particular study serves an active part in determining system performance and capability. If discrimination is to be made in the performance of the system independent of the variability which is to be expected from individual human capabilities and performance, then repetitive Modules of human elements must be introduced. The effectiveness of the most mechanized system is directly affected by individual human decisions, and in this study the system effectiveness will be particularly influenced by the human physical, mental, and emotional responses to the system task and the environmental-space-time factors. Based on the probability of narrower variability of the individual in a group or Module role, three separate systems were selected to examine this influence.

In the polar environment for a given space-time situation, the natural conditions will have a greater impact on logistical support systems than those encountered in temperate regions. The climate influences not only the design of equipment, but its compatibility with other components of a military cold-weather system. Such a system may be selected, based on how well it protects the human elements from environmental stress. This has long been the area of Quartermaster study which has limited the realization of interactions with other factors as they actually occur. Actual effectiveness ultimately must be integrated with or related in some way to the demand or stress which the system places on supporting systems for continuing supply of energy, such as fuel, food, and maintenance effort.

The measurement of fuel and food energy levels as inputs is a way in which the relative value of stress placed on supporting systems may be detected. Obtaining a measurement of output which will be identified as a value characteristic of a system of equipment is a more complex problem. It is so in this study where man serves the dual role of machine element and decision maker. Since this is a system concept in which man makes up the dominant portion of the system output, measurement of his integrated output is a critical factor in locating an absolute value of this system effectiveness. At best this study obtains relative values.

In the experiment reported here, some precautions were taken to reduce the possible variability of the human role both as an individual and as a group. Three separate materiel system levels were designed, three Modules were composed randomly, as far as practicable, and rotated to interact with each materiel system. This variable manipulation was repeated by a redistribution of each of the human elements and assembly of new Modules for interaction with each materiel system.

1.4.3 Adjusted Index of System Effectiveness (AISE)

The term for the scope or level of system evaluation is Adjusted Index of System Effectiveness. The AISE is used in this report to place a comparative evaluation number on each of the three systems with which the first phase of this project is concerned. The index of effectiveness involves the over-all differences between the 3 systems, taking into account the complex interaction of human role in decision-making and as a system element in a network of specified tasks in a particular area of the polar regions, and at a prescribed period of time and climatic situation. The "adjusted" aspect of the index involves the consideration of a time-effectiveness ratio which includes the human element in terms of mobile and immobile operational relationship.

For the purpose of this report, the AISE is derived from the following relationship:

$$AISE = \frac{W \times D}{778\,(Q_f + Q_r)} \cdot \frac{T_1 - T_2}{T_1}$$

where

- W = System operational load transported (pounds)
- D = Distance transported (feet)
- Q_f = Quantity of <u>fuel</u> consumed (Btu's per day)
- Q_r = Quantity of <u>food</u> consumed (Btu's per day)
- T_1 = Total time consumed for transport over distance D (minutes)
- T_2 = Total rest time including meal time during operational period (minutes)
- 778 = Mechanical equivalent of heat (ft-lb per Btu)

A more generalized form of this relationship can be expressed in the following way for wider use in future work which includes experimental determination of all task input-output factors:

$$AISE = 0.001258\ \frac{W_o}{Q_t} \cdot T_o = 12.6 \times 10^{-4}\ \frac{W_o}{Q_t} \cdot T_o$$

where

- W_o = Total work done for all operational missions (mobility, habitability, and restorability) per day (ft-lb per day)
- Q_t = Total energy input to system (Btu's per day)
- T_o = Ratio of actual time of work to total time of all operational missions per day.

1.5 OBJECTIVES

The specific objectives in this phase of the project were to:

(1) Determine effects of 3 systems of materiel upon the performance of 6-man Modules.

(2) Investigate operational factors and parameters which influence the effectiveness of 3 systems of materiel.

(3) Establish methodology and procedures to assess Quartermaster Corps equipment for polar conditions on a system basis.

2. PROCEDURES, DESCRIPTION, INSTRUMENTATION, AND MEASUREMENTS.

2.1 PLAN

The general plan of this phase of the study comprised four interacting system elements. These are conceptually shown in Figure 1.4-1/A (see page 6), and are as follows:

(1) Three types of materiel systems (POMMS).

(2) Three 6-man task teams (Modules).

(3) Environmental space-time influence.

(4) Schedule of control tasks and activities

The concept for the experimental design of the investigation included the arrangement of 3 basic specimens of materiel systems which are intended for use by small military units required to live and operate in the arctic environment. Three basic Modules of 6 men each were to be employed with each materiel system in a series of tasks from which several measurements of system performance could be obtained. Each of the materiel systems was to be employed by each Module for at least 6 days in a schedule of controlled tasks and activities. At the completion of a cycle, during which each Module was brought into interaction with each materiel system, the elements of all Modules were to be randomly redistributed to form three new Modules.

2.2 SPECIMEN MATERIEL SYSTEMS (POMMS)

The specimen systems were organized to provide three general levels of accommodation. The principal differences were derived from selecting 3 types of shelter, food, and heating equipment combinations. For identification purposes the materiel systems were designated as POMMS. Table 2.2-1 shows the principal component differences of each system.

Table 2.2-1 - Principal Component Differences between 3 Polar Micro-Materiel Systems (POMMS)

	POMMS 59-A-1	POMMS 59-B-1	POMMS 59-C-1
Shelter	In situ	4- to 6-man hexagonal tent	2-man mountain tent
Food	Quick-serve meal	Ration, 5-in-1	Meal, combat, individual (MCI)
Heater	Stove, 1-burner	Yukon stove	Stove, individual

Each POMMS was sub-unitized into five subsystems to obtain a functional grouping of components, such as: (1) Clothing, (2) Shelter and Protection, (3) Heating, (4) Food, Food Service, and Sanitation, and (5) Operational Equipment. Actual packaging by subsystem was not feasible due to administrative limitations. Standard components were obtained from supplies and equipment furnished by the US Army Polar Research and Development Center, and other components came from the Quartermaster Research and Engineering Center Laboratories.

The descriptions of each of the 3 specimen POMMS are shown in Appendix 2.2-1/A. For the purposes of this study, the properties of all components are characterized in quantitative terms of logistic interest such as weight, volume, and value. The summary logistic characteristics are shown in Table 2.2-2. The general distribution of logistic characteristics according to the subsystem division is shown in Table 2.2-3. These figures include fuel and food requirements for a 3-day supply.

Table 2.2-2 - Summary of Logistic Characteristics of POMMS

	POMMS 59-A-1	POMMS 59-B-1	POMMS 59-C-1
Weight (lb)	700	908	784
Volume (cu ft)	67	80	72
Value ($)	1681	1834	1810

Table 2.2-3 - General Distribution of Logistic Characteristics

	POMMS 59-A-1		POMMS 59-B-1		POMMS 59-C-1	
Subsystem	Wt (lb)	% of Total Weight	Wt (lb)	% of Total Weight	Wt (lb)	% of Total Weight
Clothing	235	34	235	26	235	30
Shelter	147	21	188	21	185	24
Heating	36	5	155	16	38	5
Food Service, Sanitation	122	17	170	19	166	21
Operational	160	23	160	18	160	20
Totals	700	100	908	100	784	100
Human Factor Load (lb per man)	117		151		131	

2.2.1 POMMS 59-A-1

This system was assembled by assuming an arbitrary level of an "austere standard" of living, to obtain a lightweight operational characteristic. In situ shelters of the type shown in Figure 2.2-1 were designed and prepared as part of the system task. Since a natural water source was abundant, the food subsystem was selected from dehydrated components (Quick-serve Meal). Food servicing components, including the 1-burner stove, were provided to assure adequate capacity to melt snow and to heat and maintain water.

Figure 2.2-1. In situ shelter by Module Echo in 6th experimental period for QMC polar research system "POMMS 59-A-1"

2.2.2 POMMS 59-B-1

This system was assembled from components typical of those in general use. The comparative level of living for this system was regarded as "standard." The shelter selected was the 4- to 6-man hexagonal tent with its standard heater, the "Yukon" stove.

Although packaging of food components was based on the 5-in-1 ration, provisions were made to supplement the ration to equalize meal and calorie requirements for a "6-in-1" meal without the convenience of a designed package.

2.2.3 POMMS 59-C-1

This system was organized by assuming a "moderate standard" level of living. The 2-man mountain tent was selected as a shelter typical of this accommodation. Module living was thus altered more to "buddy" rather than group life.

Food and food preparation equipment were provided on an individual basis by the use of the Meal, Combat, Individual and individual stoves.

2.3 MODULE TASK TEAMS

Qualification requirements for personnel to be selected as members of the Modules were prepared (see Appendix 2.3-1/A). Eighteen military personnel were made available to serve as participants in the study.

Physical conditioning, pretesting, and indoctrinating of personnel took place at Fort Lee, Virginia, during June 1959, folowed by training of individuals in the use and care of system components. Indoctrination in the use of the POMMS took place at the site of the study during an acclimatization period of 10 days, from 9 to 19 July 1959. Allocation of personnel as Module elements is shown in Table 3.3.1-1 (see page 64).

2.4 ENVIRONMENTAL SPACE-TIME INFLUENCE

The experiment was carried out on the Greenland Ice Cap in the vicinity of the subsurface Camp Fistclench, approximate latitude 76°59'N, longitude 56°4'W, and at an elevation of 7000 feet (see Figures 2.4-1 and 2.4-2). The timing of the experiment was selected for two basic reasons. First, the period during which logistical and administrative support could be expected was limited to 1 June to 15 September. Second, the available 3-year record of meteorological information showed that more rapidly changing conditions could be expected during or after the last weeks in July (see Figure 2.4-3). The concluding period of the experiment was scheduled to be coincident with the beginning of noticeable dusk (see Figure 2.4-4). With a view to a 5-year frame of reference for obtaining systems-environmental interaction data, and considering the solar-thermal cycle characteristic of the area, the timing of this initial phase provided the most favorable and yet highly variable climatic conditions of increasing severity with least risk to operations.

2.5 CONTROL TASKS AND ACTIVITIES

Six major functional activity groupings were established as typical of the general network of daily action in which personnel and equipment demonstrate some standard of performance. These were classified as (1) Rest Accommodation, (2) Habitability (morning), (3) Operations (Logistics), (4) Operations (Tactical), (5) Habitability (evening), and (6) Rest and Record. These activities provided for two principal types of experimental days: one type involving individual load movement (tactical), and the other involving load movement by the Module (logistical). The purpose of this arrangement was to reproduce physical operational situations, to reduce impact of monotonous activities on personnel, and to fit the experiment within the supporting resources and administrative safety requirements allowed.

The control activities involved a functional grouping of daily work routines corresponding in general to the normal time-space habits

THULE, GREENLAND AND ADJACENT ICECAP

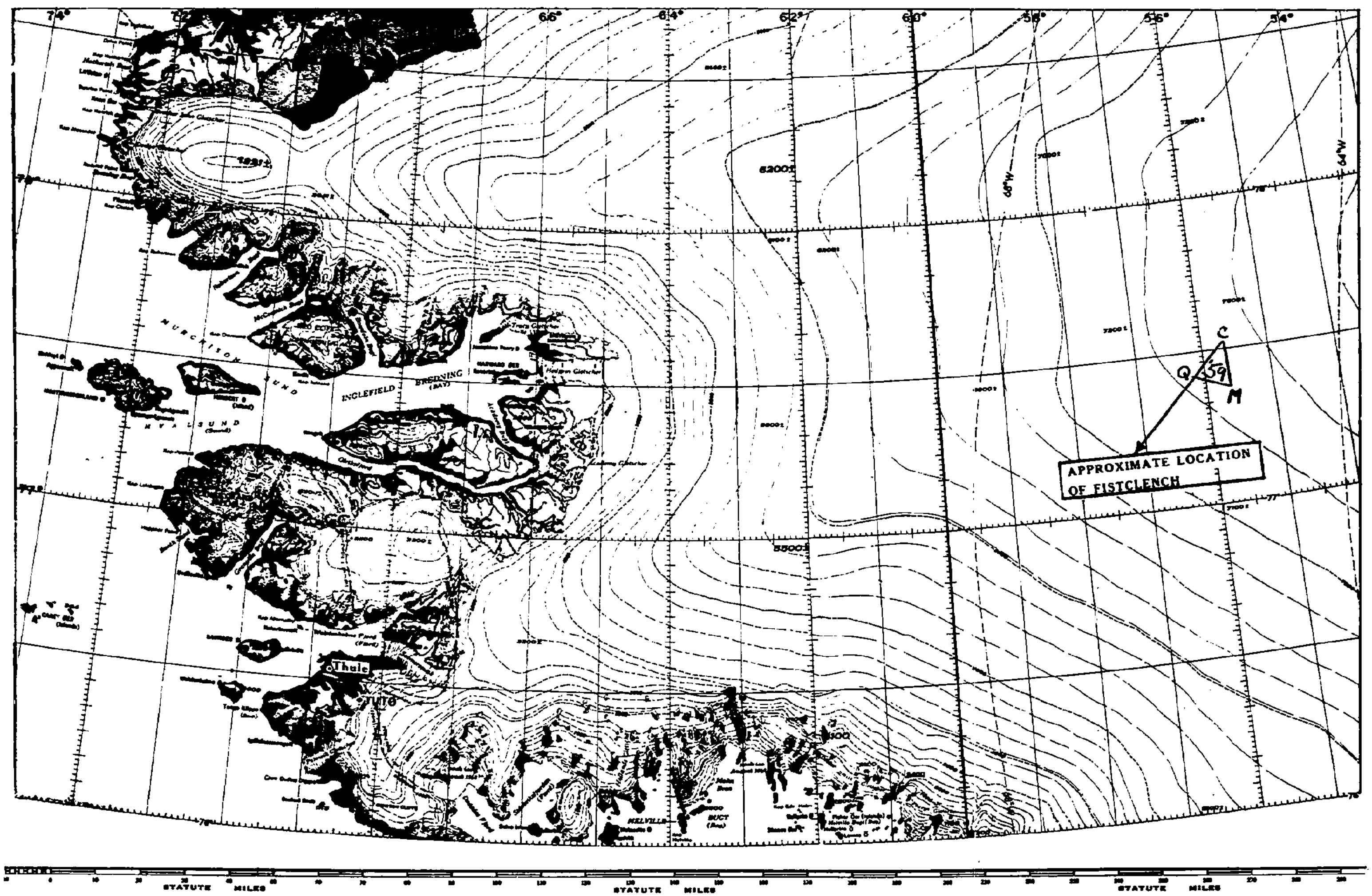

Figure 2.4-1. Location of Camp Fistclench and QMC Polar Research Area (July-August 1959)
Ref: US Air Force World Aeronautical Charts Nos. 19 and 20 1:1,000,000

Figure 2.4-2. View of Camp Fistclench Area, Greenland (August 1959)

sequence of United States culture. An element of limited control was applied so that all three Module task teams would be performing like categories of activity during the same climatic situations and measurement periods. The procedure for these activities is shown in Appendix 2.5-1/A.

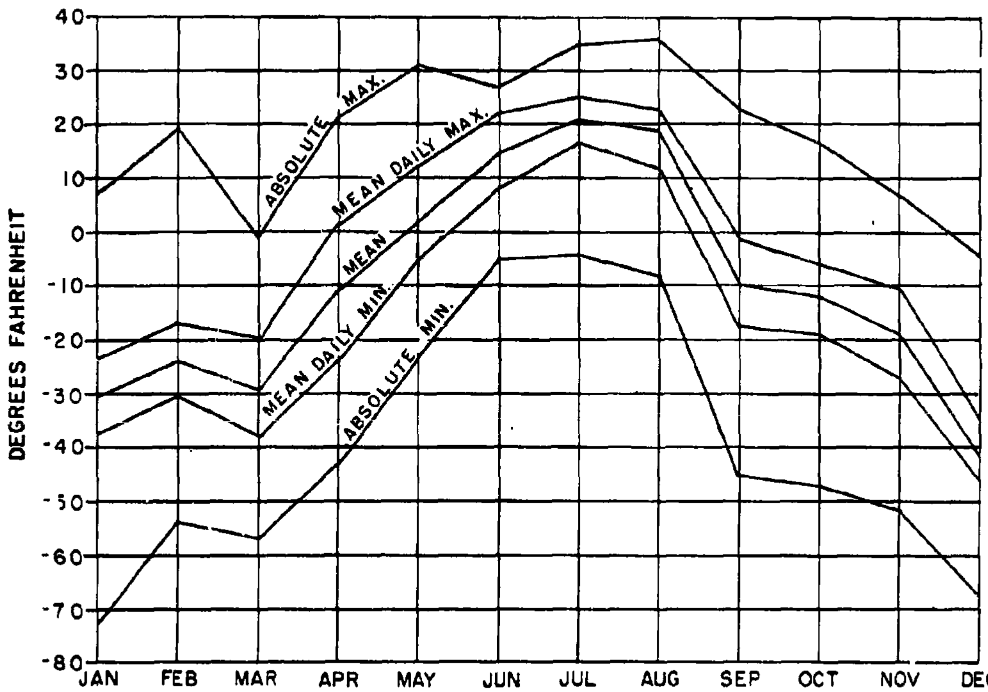

Figure 2.4-3. Temperatures at Site II, Greenland Ice Cap, 1-3 year record.
Ref: USAF Air Weather Service

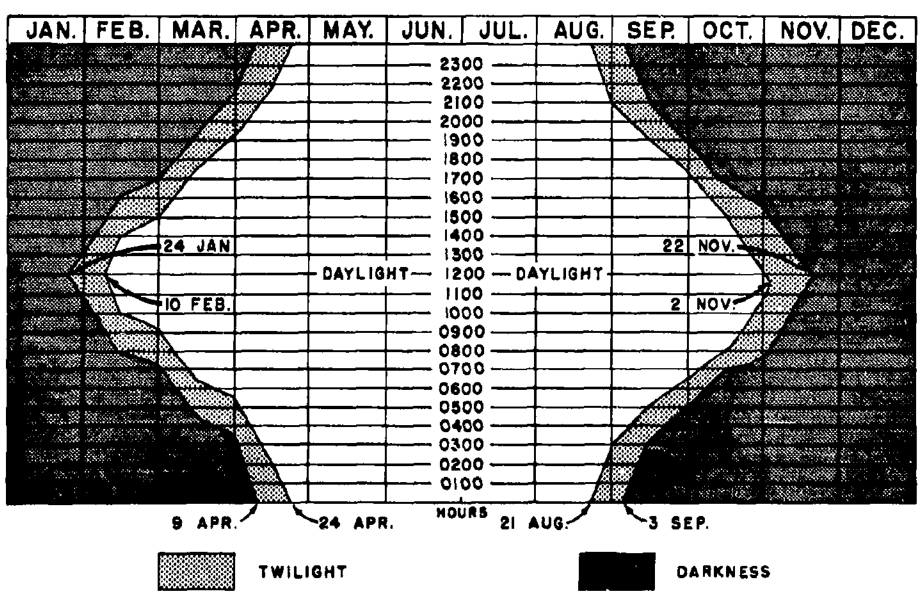

Figure 2.4-4. Daylight-Darkness Chart, Thule, Greenland
(C-166 EPD QMR&D 7 Oct 1955 RJF)

2.6 EXPERIMENTAL DESIGN

The experimental design was formulated to discriminate primarily between the three types of POMMS as well as to provide for interaction between the Modules and the materiel systems in a way which would permit collection of usable data and reduce monotony. Other factors such as situation applicability, effective use of time, scheduling, funds, weather, and availability of support personnel were factors of importance in resolving a workable and reasonable design. The experimental design for a task period is shown in Table 2.6-1.

Table 2.6-1 - Task Period Design

	Experimental Day Number						
Time	1	2	3	4	5	6	7
1700 to 1900	H-5	H-5	H-5	H-5	H-5	H-5	F
1900 to 2200	R-6	R-6	R-6	R-6	R-6	R-6	F
2200 to 0600	R-1	R-1	R-1	R-1	R-1	R-1	F
0600 to 0800	H-2	H-2	H-2	H-2	H-2	H-2	F
0800 to 1700	0-3	0-3	0-4	0-4	0-3	0-0	0-0
Gross Activity Type Day by Task Sequence	I	I	II	II	I	*	*

Legend:
F - Fistclench Site (Uncontrolled)
R-1 - Rest Accommodation Performance Task
H-2 - Habitability Performance Task (Morning)
0-3 - Operational Performance Task (Microlog-Sled Pulling)
0-4 - Operational Performance Task (Microtac-Rucksack Carrying)
H-5 - Habitability Performance Task (Evening)
R-6 - Rest and Record Control Task
0-0 - Overlap of Fistclench Tasks

Gross Activity Type:
* : (0-0) Modified Activity Day
I : (0-3) Microlog Performance Day
II : (0-4) Microtac Performance Day

For the reasons cited above, the study was designed into a 6-week operational block to permit repetitive interaction between each Module and each POMMS. Following the first cycle, in which interaction between each Module and each POMMS was to be obtained, the Modules were revised to randomize individual versus group interactions. Each cycle comprised 3 periods of 6-day task blocks, comprising 2 basic types of experimental days: tactical (movement with individual loads) and logistical (movement with Module load). However, alteration of the organization of the Modules, their number, and task periods was required as a result of administrative requirements and limited support.

Table 2.7-1 - Subjective Instruments and Measurements

Type of Instrument	Purpose of Instrument	Location and/or Timing of Measurement
(1) Edwards Personal Preference Schedule	Measures need-traits, i.e., achievement, deference, orderliness, exhibitionism, autonomy, affiliation, introception, succorance, dominance, abasement, nurturance, change, endurance, heterosexuality, aggression.	Camp Fistclench, Greenland (after arrival and movement onto Ice Cap),
(2) Minnesota Multi-phasic Inventory	Estimates who will make successful test subjects and who will not.	Fort Lee, before departure for Greenland.
(3) Pre-Questionnaire	Attitudes toward their fellow test subjects. Reasons for volunteering. Level of interest and desire towards going out on Ice Cap.	Camp Tuto, Greenland, after arrival in Greenland, before movement onto Ice Cap.
(4) Diary Report	Obtain personal expression of attitude, opinion, and comments on equipment, activities, and inter-personal reaction.	Terminal 1st, 3d, and 5th days of each Task Period.
(5) Food Questionnaire	Obtain personal opinions about each component of the ration used during previous week.	6th day of each Task Period.
(6) General Information Questionnaire	Obtain personal summary views about the system, equipment, and group relations.	Terminal day of 1st, 2d, 4th and 5th Periods.
(7) Cycle General Questionnaire	Same as (6) above and with preference of best system.	Terminal day of 1st and 2d cycle.
(8) Cycle Food Questionnaire	Same as (5) above and with preference of best ration.	Terminal day of 1st and 2d cycle.
(9) Terminal Interview	Oral inquiry to obtain "after-operation" opinions from test subjects.	Completion of 2d cycle.

2.7 INSTRUMENTATION AND MEASUREMENTS

The experiment was designed to minimize the need for precise instrumentation. Physiological measurements, other than weighing, were avoided because of limited personnel and supporting facilities. Other than instrumentation required to obtain meteorological data, instrumentation was reduced to measuring time and weight, and scaling volumes and distances as required in control task instructions in Appendix 2.5-1/A.

Subjective measurements were obtained through the instruments listed in Table 2.7-1. Frequency and purpose of measurements are also indicated. Samples of several of these instruments are included in Appendix 2.7-1/A.

2.8 FACILITIES AND SYSTEM SUPPORT

To facilitate conduct of the study activities and maintain necessary controls over the Module and the POMMS, three separate and isolated operational areas and control facilities were located. Each station was identified with a particular POMMS and its compatible type of support. These stations, for purposes of coding, were designated Station Queue, Station Man, and Station Corps. The three stations were oriented on approximately 120-degree vectors from Camp Fistclench, with Station Queue due east. All stations were about three miles from Camp Fistclench.

Each station complex consisted of an operational area and a control facility. Each of the operational areas provided for two closed measured courses over which the movement of each Module task team was planned. Flags were located along the course at intervals of 0.1 mile to facilitate orientation, navigation, and measurements (see Figure 2.8-1).

The station control facility at each area was located in a subsurface snow trench to provide (1) housing for an Operations Controller, (2) laboratory space, (3) fuel storage, (4) ration storage, (5) equipment storage, (6) distribution and maintenance, (7) communications center, and (8) assembly and safety point. Figures 2.8-2, 2.8-3, and 2.8-4 typify the facilities of the stations described above.

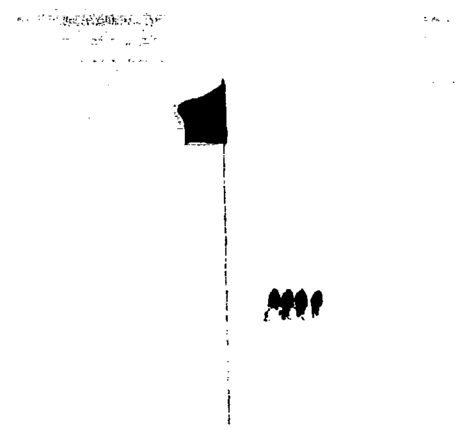

Figure 2.8-1 - Navigation markers 0.1 mile apart on clear day in QMC polar research operations area (August 1959)

Figure 2.8-2 - Entrance to subsurface QMC polar research control station "Man" (August 1959)

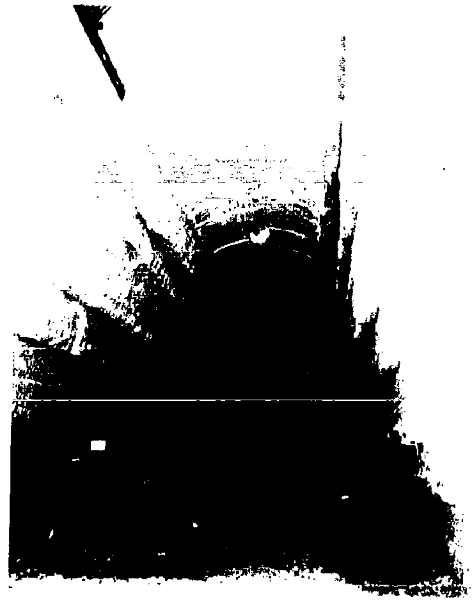

Figure 2.8-3 - Subsurface system support facilities at QMC polar research station "Corps" (August 1959)

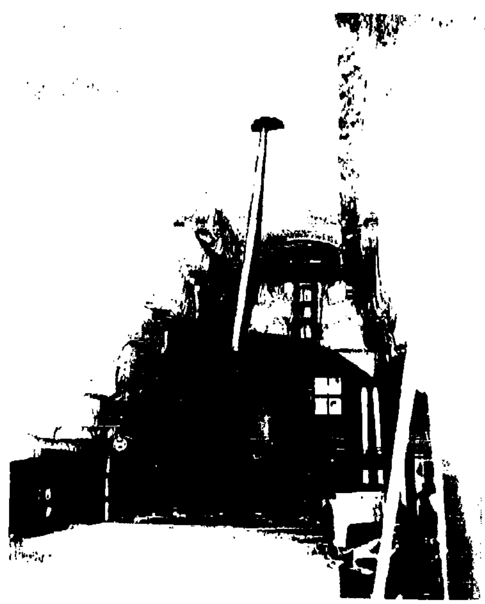

Figure 2.8-4 - Subsurface laboratory support facility for QMC polar research station "Man" (August 1959)

3. RESULTS AND DISCUSSION

3.1 GENERAL EFFECTS AND LIMITATIONS

The concept of research under which this experiment was conducted is unique because of its depth and breadth of problem assessment. It was recognized that the distinctiveness of this approach would involve considerable risk in manipulating and identifying the composition of a variable, as well as maintaining adequate control of the experiment. Yet despite many limiting factors which hampered the experiment, valuable data were obtained on both sides of the equation dealing with human and materiel factors, as well as logistic input-output relationships.

In spite of limited resources for the experiment in terms of required investigators, number of samples of specimen POMMS, the number of personnel available for composing the Modules, as well as the risk in any arctic venture, a complex and tedious research operation was accomplished. After arrival at the experiment site, changes in support and administrative timing required that the period of the experiment be advanced. This caused original plans for construction of the in situ snow shelters and other operational tasks to be changed. Emergency evacuation of one of the Module personnel because of orthopedic difficulty was necessary after the third day of the experiment, reducing the number of planned Modules to two. Although many exigencies had been anticipated, a threat of polar bears required that two experimental days be canceled. A high incidence of upper respiratory difficulties and foot ailments also emerged periodically to interact with the plan of the experiment. Despite risks and setback experienced in this new approach, 76 percent of the planned experimental data days was actually obtained. Of the actual experimental days in which data were obtained, 77 percent was considered usable for system evaluation. Table 3.1-1 shows the experimental summary by experimental station. Of 18 Module-POMMS experiments, 10 were carried out according to the general procedures which were planned or modified beforehand.

Table 3.1-1 - Summary of Experimental Days

	Experimental Station			
	Queue	Man	Corps	Total
Planned	36	36	36	108
Actual	27	27	28	82
Actual % of Planned	75%	75%	78%	76%
Useful	19	21	23	63
Useful % of Planned	52%	58%	64%	59%
Useful % of Actual	70%	78%	82%	77%

Of all the diverse factors which entered into this study, the effect of altitude and limited conditioning of the personnel, both as

individuals and as Modules, imposed the major impact in the man-equipment systems study concept.

The indices of system effectiveness, although not conclusive at this phase of the study, establish objectively derived values. Together with subjective measurements, these values may be used in making judgments on the compatibility of system components and the economics of system support.

3.2 MATERIEL SYSTEMS - POMMS

The 3 specimen materiel systems were of empirical design and assemblage. Although it was realized that many different systems were possible, experimental combinations of components were avoided to reduce the complexity of experimental operations in an uncertain environment. The boundary of the system design was limited primarily by product areas of traditional Quartermaster interest and purview. Subsystems were selected with a view to grouping components which could be logically packed as units and compatible with 3 major functional aspects, such as habitational, operational, and restful activities of the complete Module-POMMS (man-machine) System concept.

Unfortunately, the value of all 3 aspects could not be explored since the actual systems were not constructed as originally planned. It became necessary after 3 days of experiment to alter the plan as a result of the loss of a Module element, errors in supply of system components, and the normal difficulties which occur in introducing new activities in a strange climate.

Data for analysis of the POMMS came from 2 essential sources: from participant-observers (Module elements) in the form of questionnaires, diary reports, periodic and terminal interviews, and from investigator-observers (experimental station controllers) in the form of observational comments and the records of measurable sequences of tasks and activities in which the POMMS were employed.

The primary objective of the experiment was modified to explore the influence of over-all support on the operational capabilities of the Modules. While emphasis was directed to focus on the Food, Food Service, and Sanitation Subsystem aspects, together with its allied sociometric investigations, various comments and preferences derived from the questionnaires provided reasonable evidence of materiel component compatibility and effectiveness.

Comparative evaluation of the systems based on over-all interaction of the prevailing network of task factors will be covered in paragraph 3.5.

3.2.1 Clothing Subsystem

The present clothing subsystem can be identified and classified in several ways. The problem of organizing it to form a neat, simple package is today a complex research and development dilemma which awaits a new concept or approach. In the military environment, the concept of the clothing subsystem extends into the broader functions of protection and beyond the ordinary climate and wear criteria of civilian applications. The components of this system have increased as the technology of weaponry has advanced. The value of a simple, omnienvironmental-variable-fitting, universal clothing unit is mammoth; the possibilities of such a concept cannot be avoided as long as man will continue to play the inevitable role in the mechanization process as both a machine element and a machine controller.

The present experiment is not intended to explore this facet of the clothing subsystem problem. It is believed that this work will provide an opportunity to examine and analyze the factors which may compel emphasis on amplification of research and provide a means for evaluating effectiveness of alternate solutions.

In the light of the above, the clothing subsystems were assembled from current standard components based on cold-dry requirements. One clothing subsystem was used, common to all three POMMS. The components which were grouped under the clothing subsystem are identified in Appendix 2.2-1/A.

3.2.1.1 General Physical Features.

Twenty-three distinct component parts comprised the clothing subsystem. For each Module, a minimum of 264 separate items were required to compose the clothing subsystem, or 44 clothing items per Module element. Although Module elements were not selected for identical anthropometric characteristics, the problem of tariff sizing does emerge as a major design factor for the POMMS concept. Module elements retained their same components of the clothing subsystem throughout the experiment.

While the weight of each clothing subsystem was identical, it did constitute the dominant weight factor, 235 pounds (or approximately 39 pounds per man). For each of the 3 POMMS, the interaction was reflected primarily in percentage variance based on total weights of each system. These are shown in Table 2.2-3 (page 11).

3.2.1.2 General Utility and Component Problems

Clothing system components to be worn were prescribed at the start of each day. A list of the clothing to be worn or carried is shown in Table 3.2-1. In the listing of clothing items for each Module element, arctic trousers with liner are prescribed. This was done because of

administrative error and not because the arctic trousers with liner were an adequate substitute for the planned item - Trousers, Men's, Cotton, Sateen, 9 oz, OG-107 with liner. This illustrated the problem of issuing the clothing system by the separate myriad of components. Each Module element was free to make adjustments to overcome overheating, either by ventilation or removal of components, provided an outer garment remained outermost. Under this arrangement it was expected that sufficient latitude would be provided to adjust clothing component insulation to balance the requirements of the climate and activity level. Environmental conditions were never severe enough to require wearing of the parka and its liner, yet Modules were required to have them as part of their load.

Table 3.2-1 - Clothing System Components Prescribed
(To be worn or carried by each Module Element)

Boots, insulated, white
Coat, man's, single-breasted w/liner
Gloves (anti-contact)
Helmet w/liner
Hood, winter
Mitten inserts
Mitten set, arctic
Overwhites, jacket and trousers
Parka w/liner
Shirt, wool, OG-108
Socks, cushion-sole
Suspenders, trousers
Trousers, arctic w/liner
Underdrawers, wool
Undershirt, wool

The most prevailing comment was that proper or adequate ventilation was difficult to achieve, particularly on the Microlog experimental days. Removal of the coat liner was not favored. Those who adopted this solution at the outset of the experiment quickly abandoned it for two reasons: "Too much bother to remove the liner" and becoming chilled while removing the liner. To prevent overheating, Modules tended to reduce their movement rate and increase frequency and regularity of rest periods.

Handwear and headgear as issued provided more than adequate protection. The men preferred to wear only the mitten insert and to pack the arctic mitten shell on all days except during the last experimental period when the climatic conditions became more severe.

Five of the 18 men complained early in the experiment of incompatibility of the headgear with the winter hood. In each of these cases it

was found that the winter hood had been laundered and had shrunk in the process. The shrinkage was sufficient to cause the hood, when closed, to restrict head and neck movements.

Footgear, as worn by all Module elements, consisted of cushion-sole socks and white, cold-dry rubber combat boots. No serious difficulties resulted from the use of these items. An early high incidence of blistering on the balls of the feet and in the heel area subsided as the Modules became more attentive to general foot care and in making necessary adjustments to the snowshoe bindings. Issue of 3 extra pairs of cushion-sole socks to enable the men to make more frequent sock changes also helped reduce the incidence of blisters.

3.2.2 Shelter and Protection Subsystem

The shelter and protection equipment subsystem was regarded as a unit primarily because the components generally augmented the protective functions of the clothing subsystem or provided for items which may be used by the individual rather than worn as clothing. Operationally it was observed that many of these components could just as easily have been included in the Food, Food Service, and Sanitation Subsystem, i.e., anti-chap lipstick, sunburn cream, or first aid items.

3.2.2.1 Shelter

Three classes of shelter were employed in the experiment and, other than food, constituted the principal difference between systems. These included:

(1) In situ shelter (POMMS 59-A-1)
(2) Tent, hexagonal, lightweight, arctic, 4- to 6-man (POMMS 59-B-1)
(3) Tent, mountain, 2-man (POMMS 59-C-1)

The first is constructed from local material and the others are prefabricated tents. Figures 3.2.2-1, 3.2.2-2, and 3.2.2-3 illustrate the actual use of each. General comments and observations of each shelter are reported below.

3.2.2.1.1 In Situ Shelter (POMMS 59-A-1)

Construction time for a shelter below the surface of the snow ranged from 3 to 6 hours. Use of the intrenching shovel as an operational tool was grossly inadequate; long-handle and D-handle shovels and machetes were used with greater efficiency.

Although several designs of an in situ type shelter were preplanned and suggested, the Modules were encouraged to use group ingenuity and decision in creating shelter design and determining construction procedures and methods. The results follow:

Figure 3.2.2-1 - In situ shelter by Module Alpha in 1st experimental period for QMC polar research system "POMMS 59-A-1" (July 1959)

Figure 3.2.2-2 - Tent, hexagonal, lightweight, arctic, 4- to 6-man shelter for QMC polar research system "POMMS 59-B-1", 5th Experimental period (August 1959)

Figure 3.2.2-3 - Tents, mountain, 2-man shelter for QMC polar research system "POMMS 59-C-1," 3d experimental period (August 1959)

Type I In Situ Shelter (Figure 3.2.2-4). This shelter was inspired by the shape of the Jamesway tent design. A 3- by 30-foot trench was dug in the snow 2½ feet deep. Digging then proceeded laterally and downward until a depth of 6 feet was reached. A 6-inch deep by 2-foot wide trench was dug in the center of the floor running the entire length of the shelter, as a walk and a reservoir for cold air. Module Alpha constructed this shelter in 3.5 hours.

A cooking area was located at the end of the shelter opposite the entrance. The heat generated by the stoves caused icing on the interior surface of the shelter. The opening at the top of the shelter was covered over with ponchos. As the opening melted, the edges developed sharp, icy surfaces. Eventually the opening became too wide to be effectively covered by ponchos.

Type II In Situ Shelter (Figure 3.2.2-5). A 2- by 25- by 6-foot deep trench was dug. Module Bravo constructed this shelter in 3 hours. The individual sleeping areas 4 by 8 feet were dug approximately 18 inches above the trench floor.

Type III In Situ Shelter (Figure 3.2.2-6). A trench 6- by 18- by 8-feet deep was excavated. Modified Module Charlie (5 men) constructed this shelter in 6 hours. It was too large, and colder than any of the other in situ shelters. Individual sleeping areas were dug perpendicular to the trench, approximately 2 feet above the trench floor. Covering the trench opening was difficult and inadequate.

Type IIIA In Situ Shelter (Figure 3.2.2-7). This shelter was similar to Type III but smaller. Module Delta required 5 hours to construct it. The opening was small enough to be covered by ponchos.

Type IV In Situ Shelter (Figure 3.2.2-8). This shelter, constructed by Module Echo in 6 hours, is considered the most efficient of the 5 constructed. The sleeping area housed 4 men and the opening at the top was covered with snow blocks. The cooking area also served as a sleeping area for 2 men, and this opening was covered with ponchos. The entrance was located in the kitchen area and consisted of a tunnel and steps which lead to the surface. This arrangement was the warmest and most comfortable of all the shelters constructed.

3.2.2.1.2 Tent, Hexagonal, Lightweight, Arctic, 4- to 6-man (POMMS 59-B-1).

The hexagonal tent was the best-liked shelter. Surface snow conditions (soft, granular) hampered erection. As the Modules became familiar with the ground snow conditions, the top 18 to 24 inches of surface snow was cleared down to "stable" snow before starting erection of the tent. It was necessary to "dead-man" all tent pins.

The tent was equipped with the "Yukon" stove, and fuel for heating was regulated. With the stove burning at low rates, the temperature at standing head height averaged 85F, and at sleeping bag height was 50F; with the heater off, head height temperature was 25F and at sleeping bag level was 21F when outside temperature was 15F. Some snow floor melting was experienced. By placing cardboard from ration containers under the stove, melting of the snow floor in this immediate area was minimized.

Moisture accumulation on the tent liner and between the liner and shell was negligible, and little or no snow adhered to the tent ground flaps.

3.2.2.1.3 Tent, Mountain, 2-Man (POMMS 59-C-1).

The major difficulty encountered with this shelter was in getting the Modules accustomed to living in restricted space and adopting the procedure and precautions associated with its use. Since space was restricted, all equipment other than sleeping gear had to remain outside the shelter except when in use. The extra effort required to protect the equipment stored outside from snow and frost accumulation provoked adverse reaction.

No heater was prescribed except that provided for cooking. All cooking was done outside the tent in a snow shelter, especially constructed for this purpose. Although interior frost accumulation was not serious, there was sufficient accumulation overnight to make arising and dressing in the tent an activity disagreeable to all.

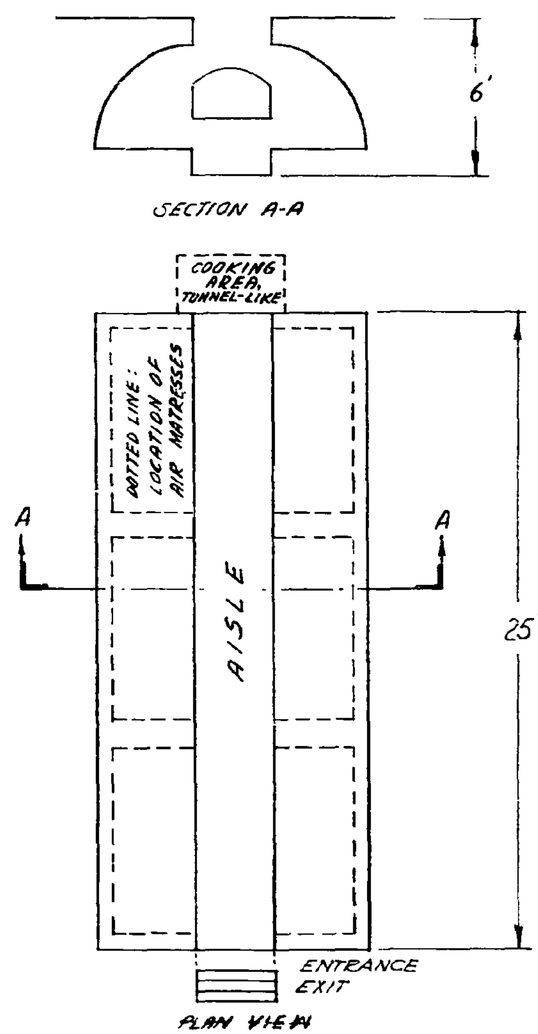

Figure 3.2.2-4 - Type I In situ shelter
(Code: QMREL-PPO/NJM-59)

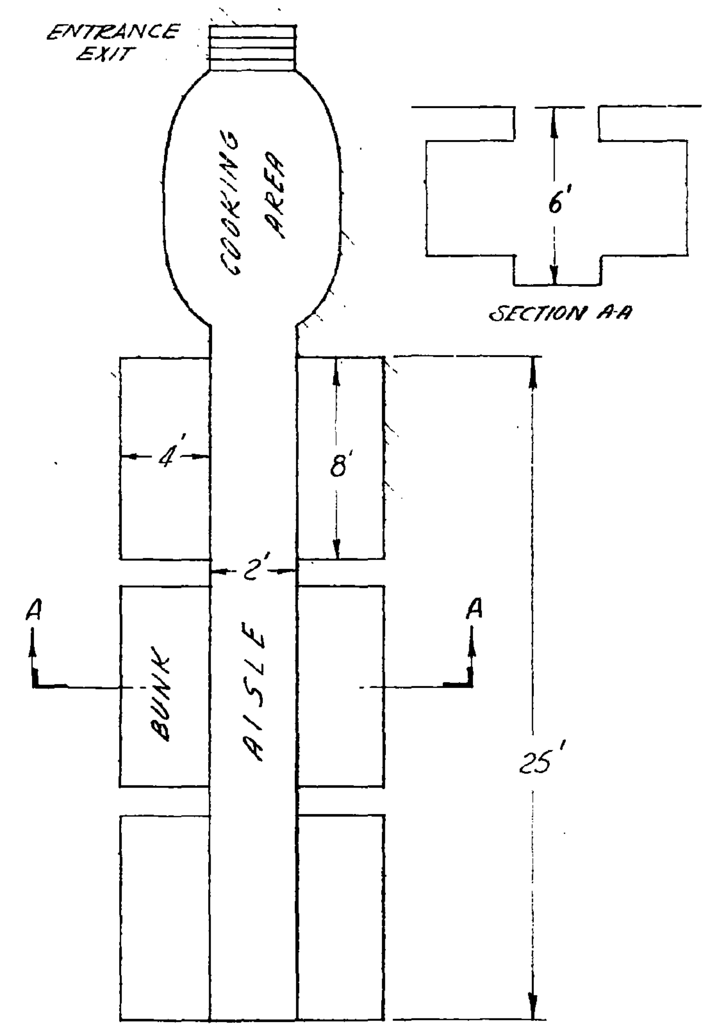

Figure 3.2.2-5 - Type II In situ shelter
(Code: QMREL-PPO/NJM-59)

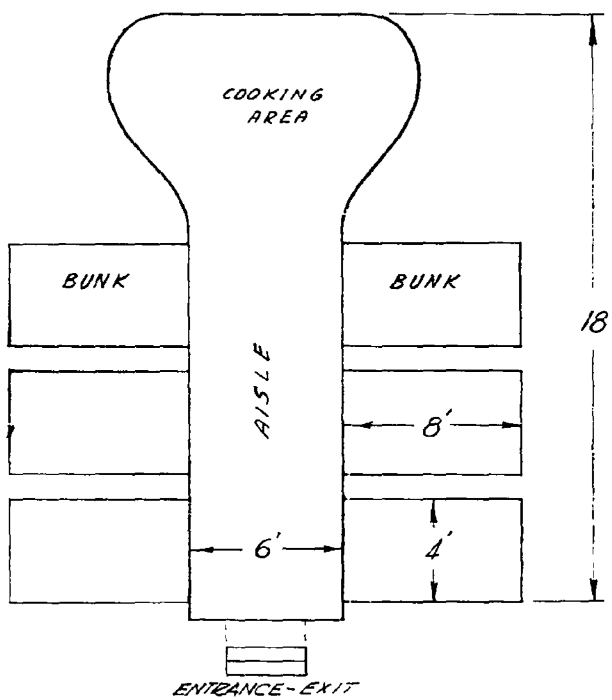

Figure 3.2.2-6
Type III In situ shelter
(Code: QMREL-PPO/NJM-59)

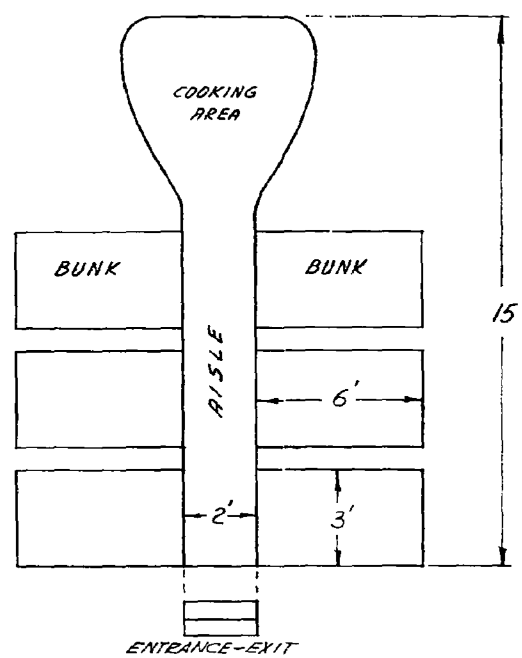

Figure 3.2.2-7
Type IIIA In situ shelter
(Code: QMREL-PPO/NJM-59)

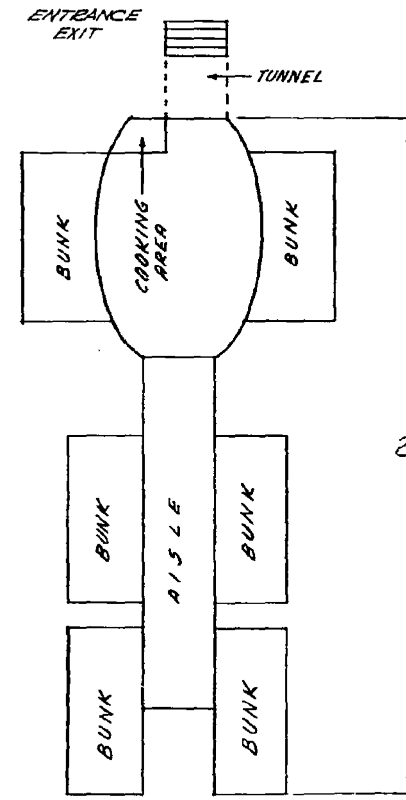

Figure 3.2.2-8
Type IV In situ shelter
(Code: QMREL-PPO/NJM-59)

3.2.2.2 Protection

A high rate of failure was experienced with the nylon pneumatic mattresses. Those issued were new. Saliva and respiratory vapor freezing around the air-intake valve caused brittleness.

Sun glasses were required at all times outside the shelters. Sunburn cream, as issued, was not effective; consequently, the Module elements suffered serious sun-and wind-burn during the first 2 periods of the experiment. The use of the issue cream was abandoned in favor of zinc oxide ointment which proved most effective. No sunburn cases were reported from the time the Module elements began using zinc oxide in the third period.

3.2.3 Heating Subsystem (Personnel and Food)

The heating subsystem was assembled as the energy plant of the POMMS, tying together the fuel use, storage, and handling devices which would be used to provide heat to warm or cook food, melt snow, boil water, regulate shelter space temperature, and to provide for lighting when required.

Selection of components was based on their availability and functional compatibility. Selection of fuel storage containers for each system was based on estimates of capacity for a 3-day fuel supply. Although the experimental procedure for fuel supply and resupply was altered and the phasing out of the sixth experimental day resulted in a shorter resupply period, the data appear to reflect the attributes of each system as noted in paragraph 3.2.3.3.

3.2.3.1 Heating Aspects

For the purpose of this experiment, two main questions of the heating system were of concern. First, were the heating subsystem components adequate for each of the systems? Second, what comparative influence did each have on the energy input to each system?

3.2.3.2 Heating Adequacy

In the POMMS 59-A-1, using the in situ shelter, two 1-burner stoves were adequate for warming the air so that the Module elements were able to remove their outer clothing during meals. Aluminum foil reflected heat from the stoves to warm the shelter air and at the same time keep the walls of the shelter from melting. The two 1-burner stoves were inadequate for cooking during the first cycle. An additional stove was provided during the second cycle to reduce the time-cost factor involved in melting snow and heating water for the Quick-serve ration components.

For the POMMS 59-B-1, the "Yukon" stove was used to warm the shelter air and rations. Since the "Yukon" stove is not a cooking stove, ...,

two 1-burner stoves were provided. For shelter heating during the total experimental period, the "Yukon" stove proved to be more than adequate for the system shelter. The provision of this heating capacity did indicate a consistent Module trend to consume more fuel than was necessary.

The POMMS 59-C-1 which employed the 2-Man Mountain Tent revealed several interesting problems in system design as far as heating is concerned. The high occupant density reduces greatly the amount of heating required, so that body heat or candle heat was found to be adequate to provide thermal comfort. On the other hand, the shelter facility required augmentation to permit food service space. The heating requirement for this system was thus influenced by interaction between the food and shelter subsystems. The individual combat meal required that each Module element be provided with a cookstove for full compatibility. On the basis of the shelter subsystem influence, a 1-burner stove for each 2 elements of the 6-man Module was required. While augmentation of the 2-man shelter subsystem was necessary to provide sheltered cooking space and indicated a tendency toward the group food preparation characteristics of the POMMS 59-A-1 system, the compatibility and greater flexibility of heating the POMMS 59-A-1 food system were more advantageous.

3.2.3.3 <u>Fuel Resupply Aspects</u>

Table 3.2.3-1 contains data on the fuel consumed by each POMMS based on a 3-day cycle of resupply. The initial consumption is based on the first 3 experimental days, and the resupply consumption includes a period just short of this supply cycle. This accounts in some degree for the sharp variability between initial supply and resupply consumption data for the same system; however, the data are comparative for the 3 POMMS. The data show the over-all impact of each system on fuel input, independent of the variability of the Modules and the environment. POMMS 59-C-1 with an average 3-day consumption requirement of 1.29 gallons of fuel illustrates the design characteristics of a system which made minimum impact on supply. The POMMS 59-B-1, with an average of 8 gallons illustrates the impact of a system characteristic generally conforming to standard systems used by military units. POMMS 59-A-1 without a prefabricated shelter subsystem shows an average fuel supply impact of 2.35 gallons for each supply cycle.

Although the data indicate a general trend towards increasing fuel resupply, the sharp variability for the first and second periods cannot be explained as resulting from climatic influence. It is more likely due to the Module reactions to a new experience, and incomplete acclimatization and training. The data for the sixth period are indicative of the increasing climatic influence on fuel consumption.

The fuel factor for support of POMMS 59-B-1 was 0.43 gallons per man per day and was the most costly to the fuel logistic system. The least costly (POMMS 59-C-1) was 0.074 gallons per man per day.

Table 3.2.3-1 - Fuel Consumption (Gallons) by POMMS

Exp Period	59-A-1 Initial (3-day supply)	59-A-1 Resupply (2-day supply)	59-B-1 Initial	59-B-1 Resupply	59-C-1 Initial	59-C-1 Resupply
1	3.00	1.75	8.50	8.50	2.50	1.50
2	1.25	-	6.50	-	0.69	-
3	1.50	1.00	5.00	3.00	1.06	0.62
4	1.75	1.00	-	-	1.19	0.62
5	-	-	10.00	4.00	1.00	0.62
6	4.25	2.50	10.00	3.00	-	-
Total Gallons	11.75	6.25	40.00	18.50	6.44	3.36
Avg 3-day initial use	2.35		8.00		1.29	
Avg 2-day resupply		1.56		4.62		0.84
Gallons per man per day	.135		0.43		0.074	
Min-max range (day to day)	1 to 6	2 to 5	5 to 20	4 to 12	0.75 to 4.00	0.75 to 3.00

3.2.4 Food, Food Service, and Sanitation Subsystem

The components of this subsystem were assembled as the energy plant for the Modules and tied together the food, food handling, food preparation (except heating), and serving, and the means for sanitation.

Three food systems were selected for the study, based on their compatibility with the 3 types of shelters used (see Table 2.2-1, page 10). Although it would have been desirable to study the interaction of each food system with each shelter, it was decided to maintain the same food-shelter assemblages throughout the 6-week study, to obtain repetitive data over a relatively short investigatory period.

3.2.4.1 Food and Food Related Factors

Sources of information used in analyzing the food and food service aspects of the POMMS included: (a) daily records of food consumption, (b) preference ratings for food items from the weekly food questionnaire, (c) records kept by Module leaders of amounts of water melted and of time spent in melting water and preparing food, (d) Module elements' opinions expressed in the end-of-cycle questionnaire, and (e) certain response areas from the food questionnaire, the diaries, and the terminal interviews. Wherever appropriate, the data have been reduced and presented

in tables. Generally this included all except (e) above. There was considerable overlap in this category, since essentially the same information tended to appear in the different contexts. Where this occurred, it may or may not be mentioned, depending upon the judged need for corroboration.

Three aspects of the use of food in this study with which we may be concerned are: (1) the adequacy of existing rations, as represented by the 3 used, for use in the Ice Cap environment and in support of the systems concept represented in the experimental operations, (2) the comparative suitability of the 3 rations for the particular situation, and (3) the identification of good and bad features of each ration, as used in its particular system, which will include both general defects that might apply anywhere, and defects related to the particular environment.

3.2.4.1.1 <u>Food Consumption</u>

Table 3.2.4-1 gives the average calories consumed per Module element for each POMMS ration on each day. This is the smallest breakdown possible, since the food consumption records were kept on a Module basis. It is believed that any bias in these figures will be in the direction of overstating, rather than understating, consumption. An actual count of items returned unused was made at the end of each day, hence any error would have arisen with items which were partly eaten and partly discarded. Since small fractions of a unit were seldom listed as discarded, it is probable that such small quantities, along with the inevitable can and plate scrapings, were included in the consumption figures.

If we disregard the Day 6 figures due to phasing out of the experimental period, there is still considerable variability among the average values; the 5-in-1 (POMMS 59-B-1) varies from 4022 to 5424, the QSM (POMMS 59-A-1) from 3283 to 5238, and the MCI (POMMS 59-C-1) from 3796 to 4895. There is a general trend toward increasing consumption during the first 3 periods, which might be accounted for in part by the men's increasing familiarity with the rations, increasing skill in their preparation, and colder weather, but is probably due more to increasing energy output on the trail (see Figure 3.5-2, page 105). Some of the variability is certainly attributable to differences among the Modules. Table 3.2.4-2, which summarizes the average period figures according to Module, suggests that the members of Module Charlie were high food consumers; after an initial low week, their averages rose sharply for periods 2 and 3, so that the final average over the 3-week cycle of their existence as a modified Module (5-man unit) was 440 calories per man higher than for either of the other Modules. This is an indication that the incomplete Module was consuming food at a rate almost equal to the 6-man Module and therefore the higher consumption per individual. Consumption corresponded more closely between the two Modules which participated in the second cycle because the Modules were maintained as 6-man units.

Table 3.2.4-1 - Average Caloric Value (Calories/Man/Day) of Food Consumed for Each POMMS Ration

Period	Day	POMMS 59-B-1 5-in-1	POMMS 59-A-1 Quick-serve	POMMS 59-C-1 MCI	All Rations
1	1	4183	3741	3862	3929
	2	4022	3283	4210	3838
	3	4044	3398	4104	3849
	4	4437	3997	4218	4217
	5	4289	4105	4625	4323
	6	3936	2690	3455	3355
	Average	4152	3535	4081	3920
2	1	5211	3781	4321	4392
	2	-	-	-	-
	3	-	-	-	-
	4	4799	4348	3929	4332
	5	4554	4253	3796	4188
	6	4141	3731	3137	3673
	Average	4676	4028	3825	4153
3	1	4101	4856	4281	4387
	2	4410	5238	4534	4697
	3	4440	4996	4102	4464
	4	4949	5239	4387	4829
	5	4752	4200	3871	4336
	6	3951	4893	3382	4113
	Average	4434	4898	4156	4476
4	1		3615	4529	4072
	2		4295	4388	4342
	3	M*	4332	4081	4207
	4		3906	4553	4229
	5		4497	4691	4594
	6		4273	3988	4131
	Average		4153	4372	4261
5	1	5291		4655	4964
	2	4627		4491	4559
	3	4423	M*	4621	4522
	4	5001		4848	4924
	5	4846		4895	4870
	6	4175		4809	4491
	Average	4722		4720	4721

(continued)

*Data missing

Table 3.2.4-1 - Average Caloric Value (Calories/Man/Day) (cont)

Period	Day	POMMS 59-B-1 5-in-1	59-A-1 Quick-serve	59-C-1 MCI	All Rations
6	1	4638	4754		4694
	2	4450	4272		4361
	3	4738	3825	M*	4281
	4	5424	3806		4615
	5	4324	3869		4096
	6	-	-		-
	Average	4715	4098	*Data missing	4408
Average, 1st Cycle		4421	4154	4017	4183
Average, 2d Cycle		4718	4125	4546	4495
Average for all weeks		4519	4114	4267	4301

All Module elements (with the exception of the Module leaders) were weighed at the beginning and end of each period. Table 3.2.4-3 shows the changes in weight both during the experimental period and between periods for each Module element wherever such data were obtained. The last column gives the net change for each individual from the beginning of the first period to the end of the last period in which he participated. Weights were not taken at the end of the sixth period due to administrative support restrictions, hence the second cycle data for the 5-in-1 and QSM rations were limited to four instances each. Table 3.2.4-4 reorganizes the data according to the ration used, showing the number of elements who did and did not lose weight and the average amount of change for each ration in each period and cycle.

Although these data were not analyzed statistically, because of their relatively high variability and the absence of consistent trends, inspection alone can verify that there are no significant differences, either among rations or over the course of the experiment. Table 3.2.4-3 shows that in general the men maintained their original weights during the course of the experiment. There was a net gain of 1.09 pounds per element, and the one element who lost more than 5 pounds was more than compensated for by 3 who gained more than 5 pounds each. During the first cycle the number of negative changes during the week was almost exactly balanced by the number of positive and zero changes. In the second cycle there was a higher proportion of negative changes, which suggests that during the colder weather the elements were not eating or drinking enough to maintain weight; however, the data are not sufficient to draw firm conclusions. The column averages in Table 3.2.4-3 show the development of a pattern. After the first two periods, during which average weights stabilized at a level slightly above the original, there was a consistent weight loss during the 6 experimental days

Table 3.2.4-2 - Average Daily Caloric Consumption per Module Element for Each Period

Module	FORMS 59-A-1 Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	59-B-1 Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	59-C-1 Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Average
Alfa	3535								4434					3825					3931
Bravo		4028					4152								4146				4109
Charlie*			4898					4676					4081						4552
Delta						4098					4722					4372			4397
Echo				4153								4715					4720		4529
Foxtrot**																			

*Module modified after 3d experimental day of 1st period to 5 elements (5-man unit) due to loss of individual with orthopedic difficulty.
**Module eliminated in 2d cycle due to loss of personnel

Table 3.2.4-3 - Body Weight Changes During Week and During Weekends

Element	Initial Weight	Week 1** 1-6	7	Week 2** 1-6	7	Week 3** 1-6	7	Week 4** 1-6	7	Week 5** 1-6	7	Net Change
Cy	145	-1.75	-2.25	0.75	2.25	-3.00						-4.00
Bo	146	2.25	-1.50	-0.25	1.50				-2.00	-0.25	3.75	3.50
Sh	155	-0.50	-3.00	-0.50	0	-2.00	1.00	-2.00	-1.00	-1.25	0	-9.25
Mn	158	4.75	-4.50	3.75	1.50			0	-2.50			4.75
Wb	147	3.50	-2.00	-1.00	-0.75	0.50	1.75	-2.00	3.00	-3.00	1.50	1.50
Gr*	145	-1.75	0.50	-2.50	5.00	-5.50	2.50	-0.25	3.50	-5.25	5.00	1.25
Bt	163	0.75	-4.00			2.75						1.25
Rw	151	-1.00	0	-0.50	1.75	1.50	-0.50	-1.00	3.75	0.50	1.00	5.50
Nw*	169	0.25	-0.25	0	4.75	-4.00	2.75	-2.50	4.50	-3.75	4.00	5.75
Hb	141	0.25	-3.50	-1.00	1.50	0.50	1.25	-1.25	1.25	0	0.50	0.50
Mp*	180	0.25	-1.75	-1.25	2.25	-2.75	2.50	-6.25	4.75	-4.00	3.50	-2.75
Sl	138	3.50	-2.00	0.75	0.75	0	-0.25	2.25	-1.75	0	2.50	5.75
Mr	179	-1.25	1.00	-0.75	0.50	0.50	-1.50					-1.50
Dv	134	0	0.50	1.75	0	-2.50					1.25	3.00
N		14	14	13	13	12	9	9	10	9	10	14
Average		0.66	-1.62	0.09	1.43	-1.17	1.05	-1.44	1.35	-1.89	2.30	1.09

*Elements who show regular cyclic change, losing during the week and gaining on the weekend.
**First figure is change for days 1-6, Sunday afternoon to Saturday afternoon; second figure is for day 7, Saturday to Sunday.

Table 3.2.4-4 - Individual Body Weight Changes by POMMS (lb)

	POMMS							
	59-A-1		59-B-1		59-C-1			
Module	No. Men	QSM	No. Men	5-in-1	No. Men	MCI	Total No. Men	Individual Average
				1st Cycle				
Alpha	5	-0.30	5	-0.95	4	-0.50	14	-0.58
Bravo	5	+0.55	5	+1.65	3	-1.50	13	+0.23
Charlie	4	-1.19	4	+0.125	4	+0.625	12	-0.11
System Totals & Average 1st Cycle	14	-0.28	14	+0.28	11	-0.46		
				2d Cycle				
Delta	-	-	4	-2.69	5	-2.40	9	-2.54
Echo	4	-0.25	-	-	5	-1.25	9	-0.75
System Totals & Average 2d Cycle	4	-0.25	4	-2.69	10	-1.82		

which was replaced during a 24-hour interval between experimental periods. Three elements who show this pattern clearly are marked with asterisks. Such rapid weight replacement suggests that the losses were due mainly to dehydration.

As noted above, consumption of the 5-in-1 (POMMS 59-B-1) was higher by 400 calories than for the QSM (POMMS 59-A-1) and by 250 calories over the MCI (POMMS 59-C-1). However, even if these differences are reliable, it cannot necessarily be concluded that the 5-in-1 is superior to the other two rations. Other evidence fails to indicate that the amounts of food consumed were inadequate with any of the rations. This includes weight changes discussed above and the subjective criterion of hunger. Comments on hunger are few. The only place they occurred to any appreciable extent was with the MCI trail lunch in the first cycle, and since the men were eating a full third of their daily calories at these meals, it was apparent that the complaints were not related to amount of food, but to type of items. There has been some evidence from laboratory experiments that the control of food intake is related to type and bulk of food as well as to caloric value. Particularly with foods that are high in fat, the caloric value of amounts that will satisfy hunger is higher than for foods of a lesser caloric density. That could well be what happened here, e.g., it may be noted that the 5-in-1 (POMMS 59-B-1) has more items with high fat content than the QSM (POMMS 59-A-1).

3.2.4.1.2 Water Consumption (Preparation and Sanitation)

Table 3.2.4-5 summarizes the data on water preparation for each ration, given in terms of the weekly average for each meal. These figures represent water as melted from snow, and would have been higher than water actually used, depending on how much was discarded. Most of the water was used for drinking or in preparing dehydrated foods, the latter being particularly important with the QSM (POMMS 59-A-1). All groups used the Towelettes for personal cleaning and the only water used for this purpose was for shaving. Although no records were kept of such usage, the amounts were relatively small and would have been about the same for all 3 rations. The 5-in-1 (POMMS 59-B-1) was the only ration requiring water for cleaning mess gear. No record was kept of this usage; however, the amounts were relatively small.

Table 3.2.4-5 - Daily Average Amounts (quarts) of Water Prepared and Daily Average Time (minutes) Required for Preparation

Week	Supper	Breakfast	Trail Lunch	All Meals Combined	Amount Per Man	Time Required
			QSM			
1	10.3	9.7	6.0	26.0	4.33	260
2	12.5	5.5	5.7	23.7	3.96	156
3	7.4	5.5	5.0	17.7	3.77	94
4	16.5	1.7	6.0	24.2	4.03	112
6	7.5	2.6	6.4	16.5	2.80	52
Average	10.8	5.0	5.8	21.6	3.79	136
Range*	6.0-15.0	5.5-14.0	5.0-7.0			
			5-in-1			
1	5.3	4.8	4.0	14.1	2.35	70
2	6.7	6.9	3.7	17.4	3.48	39
3	3.1	3.2	3.0	9.2	1.54	74
5	4.6	4.2	4.8	13.7	2.31	42
6	6.4	1.8	1.9	10.1	1.68	48
Average	5.1	4.1	3.5	12.7	2.19	56
Range*	2.5-8.0	2.0-7.0	1.5-6.0			
			MCI			
1	6.2	2.1	6.0	14.2	2.50	36
2	2.0	2.6	6.0	10.6	1.86	51
3	8.7	1.5	5.0	15.2	2.92	71
4	3.2	5.0	5.0	13.2	2.21	42
5	11.0	1.5	5.0	17.5	2.92	72
Average	6.5	2.5	5.4	14.4	2.52	55
Range*	2.0-12.0	1.0-6.0	0-6.0			

*Range of amounts prepared for individual meals.

On the whole, these values are more stable than those for time spent in water preparation, which might be expected considering that the amount of water required is related to physiological need - both for water per se and for preparing a relatively constant amount of food, yet the ranges for individual meals in some cases still show much variation, e.g., supper and breakfast for the MCI (POMMS 59-C-1). In comparing meals, one should recognize that the figures probably represent "water used" more accurately than "water prepared," e.g., water for the trail lunch was often prepared at the same time as water for breakfast, also water was sometimes carried over from supper. Hence, the daily total, across all meals, is the most important value.

The QSM (POMMS 59-A-1) required an average, over all weeks, of about 22 quarts, or 3.8 quarts per man per day, as compared to about 2.2 quarts for the 5-in-1 and 2.5 quarts for the MCI (POMMS 59-C-1). This differential of about 1.5 quarts per man per day, while it represents expenditure of a substantial amount of fuel and time, is somewhat less than might be anticipated considering that the QSM is entirely dehydrated so that all of the water ingested in the food would have to appear in this record. Despite the need for some water for clean-up purposes with the 5-in-1 (POMMS 59-B-1), although this was reduced practically to zero at times by cleaning mess gear with snow, on the average it required less water than the MCI (POMMS 59-C-1), again probably due to its nigher proportion of "wet" canned foods.

The average daily amount of water prepared was more than 1.5 times as much for the QSM as for either of the other 2 rations, and was slightly less for the 5-in-1 than for the MCI. However, such figures are not a valid basis for comparative evaluation. Certainly, in an environment where obtaining water entails costs in fuel and time, the quantity needed is important, but the figures obtained in this experiment do not tell the whole story. With the QSM, all water consumed had to be prepared from snow, whereas with the 5-in-1 ration the canned items provided significant amounts of water. These rations had to be thawed and heated, but these operations would have affected fuel usage rather than apparent water usage. That the 5-in-1 would require less water than the MCI would be reasonable on the basis of the water content of the rations as issued; however, it was expected that some amount of water would be required by the 5-in-1 (POMMS 59-B-1) Modules for cleaning mess kits.

The significance of the variation in these figures on water preparation cannot be exactly determined. The ranges of weekly average values are 1.53, 1.94, and 1.06 quarts for the QSM, 5-in-1, and MCI, respectively, and of course the daily averages showed much higher variation. It is unreasonable to assume that variation in physiological need for water could have caused more than a minor part of this variation. If so, there would have been a progressive decline over the course of the experiment as the weather became colder. A better assumption is that the minimum figures represent something close to real needs with the particular system.

Thirst was a common, recurring problem. Replies to the question 7a of the Food Questionnaire (Appendix 2.7-1/A) "Did you have trouble getting liquids to drink?":

Ration	1st Cycle			2d Cycle		
	Often	Certain Times	Never	Often	Certain Times	Never
5-in-1	4	7	4	1	8	3
QSM	6	7	4	3	4	5
MCI	5	7	4	0	5	6

In answer to the question, "When?", "On the trail" was indicated by 9 to 11 men in the first cycle and 5 to 7 men in the second cycle for the various rations. No other answer was given by more than 2 men.

Records were kept on the amount of liquid consumed while on the trail. Each man carried a 1-quart cold weather (thermal) canteen and was allowed to select the beverage he wanted to carry. The amounts actually used were also recorded. The records show that water was the liquid most frequently carried, with coffee a fairly close second, and cocoa a distant third; however, this misrepresents the true situation. Sometimes hot water would be carried and then used for making coffee or cocoa on the spot. The food usage records show that this happened often. With the QSM there was an additional source of liquid in that soup could be prepared and carried in the 6-in-1 water container. This was done on 8 occasions during the experiment.

These data are summarized in Table 3.2.4-6, which shows that average usage of water on the trail over the entire experiment was 0.74 quarts. Water usage varied among the ration systems from 0.61 quarts for the 5-in-1 to 0.83 quarts for the QSM, although no statistical analysis was made and this degree of difference could have been due to chance. The averages by week are fairly constant except for the final week where it fell to 0.55 quarts because of the extremely low figure of 0.24 quarts for the 5-in-1 group.

These figures suggest that the dehydration indicated by the frequent complaint about thirst while out on the trail was, in one sense, voluntary. The men were, on the average, bringing back about 20 percent of the liquids they carried, and there were only 2 periods when a Module returned 10 percent of the water they carried. It may be noted that there were 52 occasions when a man brought back a full canteen. Of course, many of the men consistently drank all of the liquid carried, but apparently there was a disinclination to "borrow." Other reasons for the men's failure to drink even though they were thirsty would have included: (a) having the "wrong drink," e.g., hot coffee when the man actually wanted cold water, and (b) some discomfort in cold weather of breaking out the canteen to drink. This evidence, including both the fact that some men drank

nothing and the comments on being thirsty, suggests that considerable water deficit was incurred during the day. The men were asked about eating and drinking between supper and breakfast (question 6, Food Questionnaire). With all 3 rations, in both cycles, about 2/3 of the men said they had something to eat or drink every day, and the rest indicated they had done so "a few times." Coffee, cocoa, plain water, and tea were the items most frequently mentioned. Candy was the only food item eaten very often. It would seem that the men used this interval to bring themselves back into water balance. It is of interest to note that most of the men reported drinking "some" or "quite a lot" of melted snow water.

Table 3.2.4-6 - Average Amount (quarts) of Liquids per Man/Day Used with the Trail Lunch

Week	5-in-1		QSM*		MCI		All Rations	
	N**	Avg.	N**	Avg.	N**	Avg.	N**	Avg.
1	30	0.65	30	0.72	25	0.80	85	0.72
2	15	0.82	18	0.93	18	0.79	51	0.85
3	25	0.48	23	0.91	30	0.78	78	0.72
4	--	--	30	0.81	30	0.87	60	0.84
5	30	0.78	--	--	30	0.65	60	0.72
6	18	0.24	18	0.86	--	--	36	0.55
Total	118	0.61	119	0.83	133	0.78	370	0.74
No Liquid***	10		26		16		52	

*Includes water used in preparing soup carried in the 6-in-1 water containers. If the 13.6 quarts so used is eliminated, the average usage is reduced to 0.72 quarts.
**Total man-days on operational tasks for the week.
***Number of man-days when no liquid was used on the operational task.

3.2.4.1.3 Food Patterns and Calorie Distribution

Table 3.2.4-7 gives the percentage distribution of calories among the 3 daily meals, averaged across each week. The over-all proportions are fairly even among meals, with the proportion at supper and trail lunch slightly above 1/3 and that for breakfast slightly below; the proportions for the weekly averages do not vary markedly. Of course, the averaging covers up the occasional large daily variability, e.g., the daily records show trail lunches as low as 700 calories and suppers as high as 2500.

Table 3.2.4-7 - Average Daily Calories Eaten at Supper, Breakfast, and Trail Lunch

Week	Calories All Meals	% Supper	% Breakfast	% Trail Lunch
5-in-1 (POMMS 59-B-1)				
1	4152	34.3	27.7	38.0
2	4676	34.5	29.8	35.7
3	4434	37.2	27.5	35.3
5	4722	40.0	30.8	29.2
6	4715	38.1	27.4	34.5
Average	4519	37.1	28.6	34.3
QSM (POMMS 59-A-1)				
1	3535	37.1	29.0	33.9
2	4028	36.6	30.3	33.1
3	4898	32.9	34.3	32.8
4	4153	35.7	28.2	36.1
6	4098	34.6	36.1	29.3
Average	4114	35.3	31.5	33.2
MCI (POMMS 59-C-1)				
1	4081	33.4	29.1	37.5
2	3825	36.4	29.2	34.4
3	4156	34.2	28.9	36.9
4	4372	29.5	31.5	39.0
5	4720	43.9	30.0	26.0
Average	4267	35.6	29.9	34.5

The most frequent diary comment on the trail lunch was "not enough food." During the first cycle this comment appeared a total of 20 times, 11 times for the MCI (POMMS 59-C-1), but it appeared only twice during the second cycle. Yet Table 3.2.4-7 shows that, on the average, the men were eating a third of their daily calories in the operational (trail) meal. It would appear that the real source of dissatisfaction was not the quantity but the type of food. There were many comments of "too dry" (5-in-1) and "too many sweets" (MCI). Also, the need for hot soup or a hot drink was mentioned a total of 18 times by 9 different men. In the second cycle the men were permitted to select their own menus and the use of fuel devices for heating cans of food on the trail. These two things together seemed to have effectively eliminated the complaints. Table 3.2.4-8, which shows the average percentage contribution of each food class to the different meals, provides further information about the trail lunch. For the 5-in-1 and QSM there were no marked changes between cycles in the amounts of the different types of foods used;

however, with the MCI the men took advantage of the fuel tablets to reduce their consumption of baked products and to compensate with main dish and dessert items.

Table 3.2.4-8 - Percentage of Average Calories from Each Food Class* Eaten at the Different Meals

	1st Cycle			2d Cycle		
	Supper	Breakfast	Trail Lunch	Supper	Breakfast	Trail Lunch
5-in-1						
Main dishes	31	48	6	37	36	5
Side dishes	12	0	0	6	1	3
Baked items	18	13	36	21	23	26
Desserts	10	10	0	8	9	0
Candy	12	0	28	6	3	28
Beverages	7	19	8	11	14	9
Accessory	10	10	22	11	14	29
QSM						
Main dishes	35	32	11	38	31	9
Side dishes	19	12	1	14	14	4
Baked items	13	14	53	11	10	56
Desserts	12	10	0	10	11	0
Candy	8	16	19	13	12	15
Beverages	7	13	7	10	17	5
Accessory	6	3	9	4	5	11
MCI						
Main dishes	52	46	0	41	29	18
Baked items	23	14	61	29	40	37
Desserts	5	11	0	1	6	6
Candy	5	4	15	4	3	15
Beverages	7	17	7	13	13	4
Accessory	8	8	17	12	9	20

*Cream and sugar are in beverages except for QSM breakfasts, where cream has been divided 60-40 between beverages and side dishes, and sugar has been divided 50-50.

Changes in the types of items selected for the various meals in the second cycle as compared to the "planned"menus of the first cycle were fewer than expected; however, it must be recognized that the range of possible variations was severely limited both by the nature of the rations and by the experimental conditions.

Menus for the first cycle were established in advance, based upon principles of nutrition aided by common knowledge of the ration items,

projected to the anticipated field situation. Items were specifically allocated to meals; foods not used in an earlier meal could be eaten at a later meal, but they could not be used ahead of schedule. There was a shift to "self-planned" menus in the second cycle, i.e., the issue for the day was fixed but there was complete freedom in selecting the items to be served at each meal. It was believed that such freedom might improve acceptance; however, there is no evidence that it did so. As indicated above, there was some shifting in the types of items used for the trail lunch along with a lower frequency of complaints, but this was probably due to provision of a means of heating foods on the trail. The general level of preference in the second cycle was slightly higher for the 5-in-1 and MCI; however, this could have been due to changes in the Modules or the greater need for food in the colder weather.

Evidence from another source, paragraph 3.2.4.1, suggests that the "self-planned" meals were not as suitable as the pre-planned. This is the correlation between preference and percent eaten shown in Table 3.2.4-9. One may assume that, to the degree that a person is free to eat what he wants when he wants it, he will tend to satisfy more of his needs with preferred foods. Thus the correlation between preference and consumption should have been higher in the second cycle, with its "self-planning," than in the first cycle where the item selections were imposed from without.

Table 3.2.4-9 - Correlations Between Preference Ratings, Between Percentages of Calories Eaten, and Between Preference Ratings and Percentage Eaten (All Correlations Positive)

Measures Correlated	5-in-1	QSM	MCI
1st Cycle *vs.* 2d Cycle			
Preference	0.87	0.88	0.86
Percent eaten	0.68	0.42	0.53
Preference *vs.* percent eaten			
1st Cycle	0.82	0.67	0.55
2d Cycle	0.55	0.49	0.60
1st and 2d Cycle	0.79	0.69	0.57
1st and 2d Cycle, all rations 0.70			

Actually, the converse was true - the correlation showed a major decrease for the 5-in-1 and QSM. The MCI stayed about the same. "Self-planning" was probably a misnomer as applied to this situation, particularly for the 5-in-1 and QSM rations. With the MCI, individual choice of items

is possible; however, the other 2 rations require group preparation, so that everybody has to eat the same menu. Placing responsibility for selection of menus within the Module seemed to offer little advantage. Apparently the Module leaders or cooks, even with on-the-spot information, were unable to improve on the selections made by the pre-planned menus.

3.2.4.1.4 Food Acceptability and General Adequacy

Two primary measures of food acceptability were employed. First, there were the preference ratings obtained for each item in the Food Questionnaire. These hedonic scale data were analyzed by assigning the values 1 to 9 to the successive scale points, with "9" indicating "like extremely," and averaging the values checked. Appendix 3.2.4-1/A presents these average ratings for each cycle separately and for the 2 cycles combined. The second measure of acceptability is represented by the amounts of each item actually eaten, expressed as a percentage of the amount available for consumption. Using caloric value as the common denominator for the different types of food, the records of ration usage were analyzed, again for each cycle separately and for the 2 cycles combined. These figures are also shown in Appendix 3.2.4-1/A. It will be noted that some values are missing. Certain items were not rated for preference because they do not have independent status, e.g., cream and sugar. Such consumption records could not be matched with preference ratings, e.g., the food record sheets accounted for "candy bars" as a group without differentiating among the various types.

For the purposes of convenient presentation and to permit further comparison, the food items have been grouped in classes in a manner generally analogous to the classes that may be established for normal foods on the basis of menu function. Most of the classes are self-explanatory. Main dishes is probably the most important one. It consists of those items which provide a fairly high proportion of calories and should be the focal point of the meal - the so-called "meat" items in operational rations. Side dishes, as used here, combine soups, vegetables, and prepared starch dishes, none of which are found in the MCI (POMMS 59-C-1). Since baked items has been set up as a separate class, all desserts are fruits except for the one pudding in the QSM (POMMS 59-A-1).

The usual function of preference ratings in an experiment of this type is as predictors of probable acceptability. They reflect individual and group attitude toward an item, and it has been shown that this attitude, other things being equal, is a good predictor of what will and will not be eaten. A predictor might be considered superfluous when actual records of consumption are available; however, records of percent of food eaten fall short as general measures of acceptability, simply because they are too specific. They show accurately what happened in one particular situation, but usually do not predict what might happen in the general situation as well as do the preference ratings. For example,

the percent eaten in any given case is affected by the amount of the item available, by the number and amounts of other items available, and by the men's level of hunger.

Table 3.2.4-9 contains information on comparison of these 2 measures of acceptability. It gives the correlations between them for each ration, and the correlations between cycles for each measure. Preference is the more stable measure as shown by the between-cycle correlations of 0.86 and 0.88, while the between-cycle correlations for percent eaten range from 0.68 for the 5-in-1, to a low of 0.42 for the QSM. This demonstrates that, while the men's feelings about the foods remained fairly constant, their actual consumption of foods was affected by conditions which changed between the 2 cycles. Both the range and distribution of the correlations between preference ratings and percent eaten are consistent with the previous findings. The over-all figure of 0.70 is within the range usually found for large-scale studies of the A-ration feeding situation. Such correlations tend to be higher as freedom of choice becomes greater, i.e., when more different items are available in adequate amount. This would explain the higher correlations for the 5-in-1 and QSM in the first cycle. The lower correlations for the second cycle may be due in part to the fact that the men were eating more in total, hence could not be "choosey;" however, another factor was probably more important (see "preplanned <u>vs.</u> self-planned menus," paragraph 3.2.4.1.3). The generally lower correlations for the MCI are probably due to the more limited variety in that ration.

The most important question which might be answered on the basis of preference is whether the ration as a whole has adequate acceptance to meet some given criterion. In the present case, if we accept the criterion of nutrition adequate to forestall weight changes, this has already been answered positively for all three rations; however, it is recognized that food has non-nutritive importance in that it can either contribute to good morale or detract from it. The preference ratings permit us to make inferences about the direction of this effect both of individual items and for the ration as a whole. It is not valid to attempt to establish a precise cut-off, in terms of a scale rating, between "good" and "poor" items, because ratings are subject to many interacting influences. This is particularly cogent here because of the small number of subjects. However, information accumulated from other studies has established that an item whose average rating is above 7 is not likely to cause acceptance problems. Conversely, we may "suspect" foods which rated toward the low end of the scale, and in this case 6 seemed a reasonable reference point. Pork and gravy and cereal blocks in the 5-in-1 are examples of such "suspect" items; both rated below 6 in both cycles and both have relatively low percent eaten values. Answers to Question 2 of the Food Questionnaire (items particularly disliked) and the diary comments further showed the men's displeasure. The conclusion is reasonable that these items were, at best, excess baggage and that the over-all effect of the ration would have been better if they had been eliminated.

That this arbitrary cut-off point on preference should not be the only means of evaluating acceptability is shown by the fact that some items rating above 6 have relatively low percent consumption. It is hard to establish a valid cut-off point on this criterion for several reasons. First, the percent consumption will change with the amount of food available in relation to the consumers' need for calories; for example, the over-all consumption of food increased as much as 18 percent (Appendix 3.2.4-1/A) from first to second cycle. This was correlated with marked increases for a number of items in each of the rations. Secondly, no large and varied background of data, comparable to that for preference, is available as a basis for interpretation. Finally, a low percentage consumption may not mean that the item itself was undesirable, but that too much was provided.

Thus it was necessary to establish an arbitrary "norm" of percent consumption to facilitate analysis and discussion of the present data. If the percent eaten fell below or near 50% in either cycle or if the over-all percentage was below or near 60% it was considered "suspect" for our purposes. Items that are "suspect" on either of the criteria are listed in Table 3.2.4-10 for convenient reference, and discussed in paragraph 3.2.4.1.5.

There are several different lines of evidence on acceptability. First, the average ratings, across all items, may be considered. They were:

	1st Cycle	2d Cycle
5-in-1	6.95	7.32
QSM	6.91	6.87
MCI	7.01	7.24

The 3 systems were almost identical based on first cycle results; however, during the second cycle the QSM stayed the same while the other 2 improved slightly. Additional evidence was obtained from the End of Cycle Questionnaire, where the subjects were asked to rank the 3 rations according to which "had the best foods" and which "gave the most over-all satisfaction." Rankings were almost identical for the 2 questions in both cycles. In the first cycle the 5-in-1 had the highest average rank, being ranked first by about half of the subjects, while the QSM and MCI were about equal. In the second cycle this trend was further emphasized; the 5-in-1 was ranked first by 11 of the 12 subjects, and again the other 2 rations tied for second place. This is further supported by answers to the question, "Did you tire of the rations or did you like it about the same?" (#4, Food Questionnaire), where there was a higher proportion of "got tired" for the QSM, particularly in the first cycle.

Table 3.2.4-10 - Food Items of "Suspect" Acceptability Because of Low Preference or Low Percentage Eaten

Ration & Item	Preference 1st Cycle	Preference 2d Cycle	Preference Cycles Combined	% Eaten 1st Cycle	% Eaten 2d Cycle	% Eaten Cycles Combined
5-in-1						
Ham & gravy	5.47	6.17	5.76	18	73	43
Pork & gravy	4.59	5.45	4.93	42	75	50
Ham & eggs	5.53	7.45	6.29	68	68	68
Frankfurter	5.81	6.50	6.11	78	100	87
Bacon	6.25	6.36	6.30	36	31	34
Green beans	6.06	6.45	6.22	60	57	59
Cheese	5.06	5.92	5.43	52	86	65
Cereal block	4.13	4.75	4.41	36	57	45
QSM						
Sliced beef & gravy	5.94	6.08	6.00	79	76	78
Spaghetti, meat	5.41	6.08	5.69	66	84	73
Beef & potato hash	6.06	5.09	5.67	51	78	73
Mashed potatoes	7.18	7.00	7.10	86	50	73
Rice	6.06	5.83	5.97	80	24	55
Lima beans	5.00	5.17	5.08	29	73	41
Macaroni	6.12	5.42	5.83	83	95	87
Macaroni, cheese	5.75	6.33	6.00	93	100	96
Bread	5.88	6.58	6.17	54	73	62
Tea	8.25	7.44	7.69	74	36	64
Margarine	6.94	7.00	6.96	47	51	49
Peanut butter	6.40	6.18	6.31	50	37	44
Cereal bar	4.13	5.00	4.50	22	63	38
Cream	-	-	-	51	57	55
Sugar	-	-	-	58	66	61
MCI						
Ham & potatoes	5.70	6.17	5.90	70	79	74
Pork steaks	4.53	5.92	5.10	64	100	78
Turkey loaf	6.35	5.75	6.10	72	83	77
Beef & peas	5.88	6.08	5.97	74	96	84
Spiced beef	5.67	6.67	6.07	94	100	97
Beef steaks	5.22	5.92	5.50	71	73	72
Fried ham	5.53	6.67	6.00	82	96	78

These results show a definite pattern which develops over time. The 5-in-1 is clearly superior, with the MCI apparently falling next in line. Dissatisfaction with the QSM was not evident at first; this

is shown by the first cycle ratings and was further supported by observations in the field. Many of the men were quite appreciative of the new dehydrated ration, both its novelty and the characteristics of some of the foods in contrast to the more common items in the other rations. Two possible explanations of the negative shift in attitude are: (a) monotony, i.e., too frequent repetition of the limited number of items available for this prototype, and (b) the discomfort and inconvenience of the POMMS 59-A-1 shelters.

Question 8 of the Food Questionnaire, which related to "physical symptoms or distress which you feel was caused by the foods or beverages?" in effect gave all 3 rations a clean bill of health. The frequency of complaints was quite low, never being over 4 for any ration in either cycle. For the 5-in-1 and QSM there were complaints about gas, plus comments from 2 men that greasy foods in the 5-in-1 made them sick. Only 1 man complained about the MCI - that the pork and beef steaks made him sick every time he ate them. The fact that the diaries did not bring forth a single spontaneous comment about such symptoms further shows their lack of importance.

That the rations were basically adequate from the nutritional standpoint is shown by the data on food consumption (paragraph 3.2.4.1.1) in conjunction with the fact that the Module elements showed no unusual weight loss over the total period of the experiment. Since no Module remained constantly on one ration, perhaps this statement should be qualified to assert only that the rations, on the average, were nutritionally adequate. Average consumption of the 5-in-1 (POMMS 59-B-1) was 400 calories higher than for the QSM (POMMS 59-A-1) and 250 calories higher than the MCI (POMMS 59-C-1). These differences were not tested statistically because some of the assumptions involved in such tests would have been questionable; however, they probably were not significantly different because of the high variability in the daily consumption figures.

Comparison among the rations is discussed in the following subsection; however, the conclusion may be anticipated that there is no good evidence that any of the rations were inadequate to sustain either weight or well-being. Also, the 24-hour interval between experimental periods when food consumption was unrecorded may be noted here; however, these intervals could have served to make up only a small part of any accumulating caloric deficit over the 5-week period during which weights were taken.

It is pertinent to note that the ration allowance for the Greenland area is 7200 calories - 1.5 times the basic 4800 calories allowed by the Master Menu of the Northeast Air Command. By this criterion the Module elements in the present study would be considered on a starvation diet. That their measured consumption of 4300 calories per man was adequate shows that the official allowance is far in excess of caloric need.

The Module elements were doing heavy physical labor while living under conditions which required greater energy expenditure than for the average camp-based soldier; also, during the week they did not have access to alternate food sources such as the PX which are available to almost every serviceman. Yet there were only 6 days when average consumption was over 5000 calories, and the maximum recorded was 5425.

"Were the rations acceptable?" This question is often hard to answer because of lack of agreement on the proper criteria of acceptability. To give a general answer usually requires a global judgment that may disregard much relevant information. The global judgment here would be that all 3 rations were acceptable, based upon application of 2 criteria already discussed. Acceptance was adequate to insure ingestion of enough food to sustain weight; also the average of the preference ratings for all the items in each ration was at a fairly high level, suggesting that for most of the men eating was a generally pleasant experience so that morale was not adversely affected. However, all of the rations included problem items (Table 3.2.4-10) whose status is questionable. Elimination of these, or their replacement by improved items of the same type, would be expected to raise the non-nutritive value of the rations; also some of them might be eliminated as excess, simply because of low consumption. Of course, this situation is not unusual with rations designed for such field operations; their development is always a matter of solving the conflict between the requirements of acceptability on the one hand and those of nutrition, utility, and stability on the other. The present test simply corroborates other results, showing that problems still exist.

The special environment and living conditions on the Ice Cap do not seem to have raised special acceptance problems; most of the problem items in Table 3.2.4-10 have shown up as such in various other tests. However, there is a factor deserving of comment, although its significance can be only a matter of speculation. Preference ratings obtained for items of the operational rations in cold-weather field trials similar to this one have tended to be very high. It has been assumed that this reflects higher appreciation of food due principally to greater caloric need, but perhaps also to the absence of other sources of comfort and satisfaction in the field. That food was one of the central foci of the test subjects' concern was demonstrated again in the present study by the analysis of the diary comments. "Food likes and dislikes" and "trail lunch," the 2 categories relating to food, were those which drew the most frequent comment. Preference results in the present study show some of the high appreciation effect. Average ratings for many items were in the "very high" category, e.g., desserts, baked items, and most of the soups, yet for other categories, e.g., the "meat" items of the MCI, the general level of ratings was lower than would have been expected on the basis of past studies. Possible reasons for this greater spread of ratings, aside from the improbable one that the quality of many items in this particular study was generally inferior, are: (a) for most of the

time an excess of food was available, and (b) the test procedures tended to direct attention toward the food and to encourage critical attitudes. This might have happened because of the rotating use of the 3 different rations and the periodic administration of questionnaires. If this were an important factor it means that, in actual use or even under test conditions where only one ration was being used, we might expect a higher indicated level of preference and consequently fewer problem items than are shown in Table 3.2.4-10 and discussed in paragraph 3.2.4.1.5.

On the basis of the criteria established, it may be concluded that the general level of preference for all 3 rations was satisfactory in both cycles. As noted above, over-all food consumption was considered satisfactory, as proved by the fact that the men maintained their body weights. Percent eaten showed a very definite increase in the second cycle, but this does not mean that consumption was too low in the first cycle. There were quite a number of "suspect" items (Table 3.2.4-10, page 50) in each ration; however, each ration also had many high rating items, which indicates that most of the subjects found real pleasure in much of their eating.

3.2.4.1.5 Food Acceptability Problems (Table 3.2.4-10, page 50)

5-in-1. Three main dish items - ham and gravy, pork and gravy, and bacon - fell down on both criteria, even though consumption of 2 of these foods increased to about 75 percent in the second cycle. Comments in both the Food Questionnaire and the diary suggest that the men reacted negatively to the fat in these items. Pork and gravy, in particular, occasioned comments that it caused nausea, cramps, was too greasy, and had a poor taste, which comments applied to ham and gravy to a lesser extent. Cereal blocks had poor acceptance throughout, but caused little comment - they were just disregarded. Frankfurters were borderline on preference, yet were satisfactory from the consumption standpoint. Cheese also rated low both times, yet had 86 percent consumption in the second cycle when the need for calories was greater.

QSM. There are three main dishes which fail to meet the preference criterion (first 3 on list) yet all had approximately 75 percent consumption. This is true also of 3 "suspect" side dishes, all starches - mashed potatoes, and macaroni and cheese. Two other starchy side dishes, rice and lima beans, along with low preference show the anomalous consumption pattern of being very low in 1 cycle and high in the other. There were more adverse spontaneous comments about "spaghetti" (apparently also refers to macaroni dishes) than any other food. The most frequent were "too much!," "why so often?," and "causes gas." Occasionally trouble was reported in rehydrating the lima beans and there were some comments on their being hard or tough. However, chicken and gravy was the item where rehydration difficulties were reported most often and it was one of the better-liked main dishes. Cereal bars, just as in the 5-in-1, were very low on both criteria, and were criticized

as "too dry." Margarine and peanut butter never fell below the cut-off point on preference, but consumption was low. It is likely that the low consumption was due to the difficulty of opening the foil envelopes and spreading the hard substance. Tea was well-liked in both cycles by the few people who rated it; however, despite the fact that only 8 packages were provided per day, only about a third of this was used in the second cycle. Cream and sugar are included in Table 3.2.4-10 (page 50) to demonstrate a point; obviously the ration provided more than necessary on both these items, hence consumption was low. Two packages of instant tea were packed in each case of the QSM especially for this test in the attempt to obtain information relevant to the belief that tea is particularly important for use in cold weather. The results do not support this belief. While the preference ratings for tea were high, it was used by only a limited number of the men. Even with the limited quantity available, only 76 percent was used in the first cycle, and this fell to 36 percent in the second cycle when apparently several of the tea drinkers had been eliminated. The consensus was: "Sure, it's nice to have tea - for people who like it - but I'd rather have coffee, myself." This came out in the terminal interviews.

MCI. According to the criteria established, 7 of the 11 main dishes must be considered "suspect," and all because of low preference. Consumption of none fell below 72 percent. This seems to contradict the validity of preference as a predictor; however, the correlation between the two measures across these 11 items was 0.76, higher than the 0.57 across all items. Apparently this was a "forcing" situation. Because there was not enough food to substitute for these high-calorie items, a fairly high proportion was eaten, however, whenever hunger was low enough to permit choice, the lower preference items were those rejected. Pork steaks and beef steaks were criticized most frequently; the former as being too greasy and both with comments such as "bad taste," "spoiled," "made me sick." Ham and potatoes was also called "too greasy," and fried ham received the same criticism along with an occasional "too salty."

While too much importance should not be attributed to the finding because of the small number of men involved, it may be noted that the over-all level of preference improved for the 5-in-1 and MCI in the second cycle, but stayed the same for the QSM. This higher general preference level in the second cycle might be attributed to various causes, among them elimination in the second cycle of certain subjects who had less favorable attitudes toward the test, better preparation of foods, or greater appreciation of food in general because of the greater caloric need engendered by the colder weather.

The Food Questionnaire provided further information on acceptability. The number of men indicating any dissatisfaction with the way the food was prepared (Question 3) was negligible, the maximum being 4 such answers for the MCI in the second cycle. Question 4 pertained to

a more general attitude, "Did you tire of the ration or did you like it about the same?" Here the 5-in-1 ration clearly was superior; only one person answered "got tired" in the first cycle and none in the second cycle. For the MCI there were 6 "got tired" answers in the first cycle, but this dropped off to 2 for the second cycle. However, for the QSM there were 6 in the first cycle, increasing to 8 in the second cycle. This indicated a growing dissatisfaction with the QSM, and was corroborated by information brought out in the terminal interviews.

3.2.4.2 Food and Food Service Subsystem Use.

The various subsystems of each POMMS, as planned, remained together throughout the experiment. Since this year's study was specifically directed at interest in the performance of the systems as a whole, this is no disadvantage; however, the evaluation of separate elements at the same time is made difficult because of the high probability of intereffects. The resulting systems, in effect, represented levels of accommodation with the POMMS 59-B-1 system on top because of the greater physical comfort of having a tent they could work in, more heat, greater ease in preparing water, etc., and the POMMS 59-A-1 system at the lower end as the most austere. One may suspect that acceptance of the 5-in-1 was improved because of appreciation of the surroundings in which it was used, or that the QSM (POMMS 59-A-1) would have been easier to prepare if it could have been done in the POMMS 59-B-1 tent rather than the colder confines of the in situ shelter of the POMMS 59-A-1 system. Of course, we know that attitudes toward the rations would be controlled only in part by the other elements in the systems, and vice versa, but the degree of independence is not known.

Aside from noting obvious shortcomings where they occurred, it is difficult to make valid comparisons on the criterion of utility. Information available to be used in such comparisons includes time costs of food-related activities as recorded, test subjects' opinions, and general observations by the experimenters. However, it must be recognized that the apparent utility of a ration will have been affected by other features of the complete system in which it was included, such as the equipment available or the type of shelter. Hence, the results may not reflect the utility of the ration per se, but its utility in a particular POMMS.

3.2.4.2.1 Food Preparation Equipment

Sources of information on the adequacy of food preparation equipment were certain items in the Food Questionnaire plus free comments in the diaries. Generally, the equipment was found satisfactory for its basic purpose of getting the food prepared and eaten, even though planned for minimum weight and bulk. Most comments were concerned either with specific deficiencies in items or with additional items that were wanted to mitigate the severity of planned limitations. For

each ration the question was asked of whether there was enough food preparation equipment to do a proper job. The answers reveal a generally satisfactory situation:

	1st Cycle		2d Cycle	
	Yes	No	Yes	No
5-in-1	13	3	10	2
QSM	11	6	10	2
MCI	13	4	12	0

Even though a man may have stated that there was enough equipment to do a proper job, he might still point out deficiencies or make recommendations for improvement. Review of their comments, along with those of the subjects who stated that equipment was inadequate, indicates the following as possible equipment problems:

(1) Cooking Utensils. Comments in both the diaries and the Food Questionnaire indicated the desire for more containers to simplify the problems of melting, storing, and carrying water, principally with the 5-in-1 and QSM subsystems. Of course, this cannot be divorced from the need for more facilities for heating and preparing food, since most equipment would be interchangeable for the two purposes. Although use of the cookset pans was suggested for heating the QSM items, the majority of men indicated that they did not try them and felt that the plastic bags were "good enough." The almost complete absence of complaints about either the plastic bags or the "recon" cartons indicates that there were no major problems in their use. "More mountain cooksets" was the most frequent suggestion, so it should be assumed that this item itself is quite satisfactory. Suggestions about the 5-in-1 food system included both "more" and "bigger" pressure cookers.

(2) Can Opener. There were a number of mild complaints about the individual can openers provided with the 5-in-1 and MCI food systems, many of them being due to below-standard items that broke or would not open, plus a few comments to the effect that it could not be used when one's hands were cold. Several men suggested providing a large can opener for the 5-in-1.

(3) Eating and Serving Utensils. The opinion was unanimous that the utensils in the QSM were adequate; and there were many positive favorable comments. Broken plastic spoons were noted in the MCI, but with low frequency. The suggestion was made that serving spoons should be provided for the 5-in-1.

(4) Packaging. With the 5-in-1 and MCI, packaging of foods may be presumed adequate since it occasioned almost no comment except for the minor problem of defective can openers. However, with the QSM, both the diary and Food Questionnaire (Question 10, "Trouble opening

packages . . .") brought out meaningful information. About half of the subjects in both cycles mentioned difficulty in opening the foil packages of margarine and peanut butter; tear-lines were absent or hard to locate, packages were tough, and often a man had to resort to using his pocket knife. It is likely that this was one major cause of the low percent consumption of these items. Few complaints were recorded about the other small package - coffee, tea, cream, sugar, jam, or the accessory packet - and there was only scattered mention of difficulties with the larger packages.

The more general criticism of there being too many small packages and other items, which caused problems in breaking down the ration and using it in a restricted space, was brought out both in the diary comments and through direct observation of the groups as they sorted out their menus and prepared meals. This factor was more serious, particularly at supper (first meal on a ration issue), because two or more boxes had to be opened and the contents sorted.

3.2.4.2.2 Food Preparation Time Factors

Records were kept of the time spent in preparing water from snow and the total time required, for each meal, for the sequence of preparing, serving, eating, and cleaning up. Data for the latter sequence are summarized in Table 3.2.4-11. Water preparation time is not given separately for each meal but the daily averages are shown in Table 3.2.4-5 (page 40), which also presents the related figures on amounts of water prepared. The boiling point of water in the experimental environment was found to be 196F.

The basic entries in Table 3.2.4-11 are the average times, separately for each meal, for each period, for each ration. Thus a particular entry may be considered characteristic for a given Module during a given period. The ranges of individual values for each meal across all periods are shown. The last column of Table 3.2.4-11 is the average daily total time spent on food service activities; and the last column of Table 3.2.4-5 gives the comparable figure for water preparation time. Because of the variability in the data and the probable causes of that variability, no further analysis was thought warranted.

Causes of this variability included normal error aggravated by the difficulty inherent in getting accurate time estimates under conditions of the experiment and, to some extent, lack of sharp "end points" of activities. However, we may assume that to a far greater extent, it reflects variability in the events themselves brought about by such factors as varying levels of skill and motivation, effectiveness of equipment, the varying demands of competing and overlapping tasks, or different ways of approaching the tasks. The last is probably the most important from our standpoint. Undoubtedly, there was much trial-and-error in the process of the Modules adjusting themselves to the demands of the unusual conditions on their available time and energy. To do

Table 3.2.4-11 - Average Daily Food Preparation, Eating, and Clean-up Time by Meal and Week (in minutes)

	Period	Number of Meals	Supper	Breakfast	Trail Lunch	Total
QSM						
(POMMS 59-A-1)	1	6	87	85	21	193
	2	4	76	75	25	177
	3	6	62	61	40	163
	4	6	58	55	30	143
	6	5	65	52	30	147
	Average		69	65	29	163
	Range*		45-90	45-100	15-45	
5-in-1						
(POMMS 59-B-1)	1	6	92	82	35	209
	2	4	84	84	35	204
	3	6	90	71	24	185
	5	6	72	57	32	161
	6	5	83	68	40	191
	Average		84	72	33	197
	Range*		65-135	50-120	15-65	
MCI						
(POMMS 59-C-1)	1	6	75	61	27	163
	2	4	43	41	20	104
	3	6	54	64	30	148
	4	6	53	50	29	132
	5	6	48	43	27	118
	Average		55	53	27	135
	Range*		40-96	40-80	20-35	

*Range of times for individual meals

this they have used different individuals and groups of individuals (meals or water prepared by one man or two men cooperating), different schedules (water prepared entirely separately or while food was being prepared and the meal eaten), or different degrees. Further, the fact that these food-related activities were interacting with others - shelter construction, care of equipment and clothing, etc. - must be kept in mind. Low values for the food-related tasks do not necessarily mean that the overall time cost of habitability activities was thereby reduced; actually the converse might have been true.

The basic data on water preparation time showed the most variability, and this was accounted for only in small part by differences in

the amounts of water prepared. The high value of the range of times among individual meals, for a given ration and meal, was from 3 to 24 times the low value, and even the weekly averages varied as much as tenfold. There is some indication of reduction in time during the course of the experiment; however, the trend is not consistent among the different systems. With the QSM there was a major reduction after the first week, when as much as 6 hours was spent in preparing water for a single day, and the daily average (shown in Table 3.2.4-5, page 40) was over 4 hours, to the sixth week when, on the average, less than an hour was required.

The amount of time required for the QSM was definitely higher. It required 2.5 times as much as either the 5-in-1 or MCI, whereas the average amount of water prepared was only about 1.5 times greater, although much of this extra time can be attributed to difficulties in the first 3 weeks when only 2 stoves were available. The diary comments supported this; 14 men complained about the time needed for water preparation in the first cycle, but there were only 2 such comments for the second cycle. This is about the same order that one would get if he attempted to rank the degree of pleasantness of the situation in which food was prepared and eaten. The actual importance of this factor is not known, but it is possible that some of the additional time for the 5-in-1 was due to the men's tendency to prolong a relatively pleasant experience (large heated tent), whereas with the MCI, for example, they tended to hurry.

The time values for food preparation, eating, and clean-up were less variable than for water preparation. The high value of the range of individual meals (Table 3.2.4-11, page 58) is about twice the low value in each case except for the 5-in-1 and QSM for the trail lunch, and the weekly averages are quite uniform. The value for the 5-in-1 ration was greatest for each of the 3 meals, followed by the QSM and MCI in that order. The "total" column shows that, averaged across the entire experiment, the 5-in-1 required 30 minutes more than the QSM and 60 minutes more than the MCI.

Any interpretation of these data must recognize that they are averages over a broad range of conditions, events, and personal attitudes. It is likely that their value will not lie in making error-laden predictions about what might happen in the general case, but in providing suggestions toward the development of optimum procedures. One should not look at average times as an indication of general trends, but consider minimum and maximum times to determine how they were related to the other aspects of operations.

The Module element opinions (Table 3.2.4-12) about ease of preparation provide a definite subjective answer on utility. The QSM was almost unanimously considered poorest, and the MCI was considered best by the majority of men.

Table 3.2.4-12 - Module Elements' Opinions of Rations (as given in Questionnaires at End of Each Cycle)

Question	1st Cycle (N = 17) Avg. Rank	Nr. Rank 1	Nr. Rank 3	2d Cycle (N = 12) Avg. Rank	Nr. Rank 1	Nr. Rank 3
Which had best foods?						
5-in-1	1.5	10	1	1.1	11	0
QSM	2.1	4	6	2.7	1	9
MCI	2.4	3	10	2.3	0	3
Which was easiest to prepare?						
5-in-1	1.9	4	2	1.7	4	0
QSM	2.9	1	14	3.0	0	12
MCI	1.3	12	1	1.3	8	0
Which gave most over-all satisfaction?						
5-in-1	1.5	9	1	1.1	11	0
QSM	2.1	5	6	2.4	1	6
MCI*	2.4	2	9	2.5	0	6
Which was most satisfactory for conditions?						
5-in-1	1.6	7	1	1.6	5	0
QSM	2.5	3	11	3.0	0	12
MCI	1.9	7	5	1.4	7	0

*N = 16 for MCI in first cycle

It may not be valid simply to compare the total times as recorded, since they may have been narrowly dependent upon special conditions. This does not negate the value of observations made in this study, but a better approach might be to analyze the various sub-operations pertaining to the different rations separately to determine what worked well, what did not work out, and the probable reasons for ease or difficulty of operations. The final objective would be synthesis of selected revised procedures, along with selected equipment, into a new system, or systems, that are maximized with respect to utility. Comments in the diaries and in the Food Questionnaires contributed information which feeds into such an analysis. Points which seemed to be important have been discussed, e.g., need for more containers for melting snow and storing water, need for more stoves, the difficulty of keeping QSM foods hot, etc.

3.2.4.3 Sanitation

Each team was provided with 2 sizes of "Towelettes" for personal sanitation: commercial size, 6 by 8 inch; experimental military size, 9 by 12 inch.

All garbage and refuse was deposited in a garbage trench dug in the operation area at a location previously designated "garbage pit and latrine trench area." This area was marked well enough to insure that no snow would be taken from there for subsequent melting to provide drinking or cooking water. The latrine trench was dug several feet down into the snow. The trench was provided with plastic bags for collection of waste. These were taken periodically to the garbage trench and there burned completely with the garbage and refuse.

3.2.4.4 Food Subsystem Subjective Evaluation

At the end of each cycle the men were asked to compare the 3 rations on the basis of 4 criteria, ranking them in order from best to poorest. These data are summarized in Table 3.2.4-12 which gives the average rank for each ration on each criterion and the number of times each was ranked first and last. "Which had the best foods?" and "Which gave most overall satisfaction?" gave the same results. The 5-in-1 (POMMS 59-B-1) was clearly considered superior to the other two, which are not significantly different, and the trend is a little stronger at the end of the second cycle. Opinions were almost unanimous that the QSM (POMMS 59-A-1) was hardest to prepare; and in this regard, the MCI (POMMS 59-C-1) had an edge over the 5-in-1. On the fourth criterion, "Which was the most satisfactory for use under conditions of this exercise?", the QSM was ranked last by nearly everyone in both cycles, and the 5-in-1 and MCI were about equal.

These results were confirmed by answers to Question 5 of the Food Questionnaire which asked for a rating of the ration used during the week on "How good is the ration for the conditions under which used?" The 5-in-1 was rated "good" or "very good" in both cycles by all but two people, and the MCI was rated in these categories by a majority of the men; on the other hand, the QSM was rated as "poor" or "very poor" by a majority.

The men's answers to the question ". . . which ration would you consider most satisfactory for the conditions . . .," are in effect a summary evaluation. The results were definite - the QSM was least satisfactory and the other 2 were considered about equal. It may be assumed that utility was given considerable weight in these opinions, since the rankings are about the same as for ease of preparation. Further, it is likely that opinions were based rather narrowly on the rations actually used and the manner in which they were used, so that the 5-in-1 was affected positively because of the heated tent, the other rations

affected negatively because of discomfort, all impressions of utility affected by the equipment actually provided, etc. Another factor which would be important in the over-all evaluation is the relative energy costs of transporting the systems. This is discussed in terms of operational output effort and related input factors in paragraph 3.5.

3.2.5 Operational Equipment Subsystem

The operational subsystem was common to all POMMS and components were selected for compatibility with the experimental mission.

The operational subsystem was assembled to provide necessary tools and equipment for the Modules to perform minimal missions defined in the tasks and activities required for the experiment. The operational subsystem package was considered to be composed of three primary assemblages: (1) a communication assemblage to provide capabilities necessary to amplify or aid the communication channels of the Modules, (2) a transportation assemblage to provide capabilities necessary to amplify or aid the Module attributes for load-carrying and movement, and (3) a specific mission assemblage to provide capabilities necessary to carry out the purposes of the Module. Since this phase of the investigation was concerned primarily with Quartermaster Corps materiel system aspects, and the mission of the Module was limited to the experimental capabilities, the operational assemblage was of necessity restricted from incorporating weapon-system components. However, alteration of this aspect was required when during the second experimental period there was a threat of polar bears, so the operational package of each system was augmented by a caliber .30 M-1 rifle and 16 rounds of ammunition.

Data obtained on the operational subsystem dealt primarily with transportability aspects of each system and are discussed in paragraph 3.5. Measures of transportability were obtained through the schedule of two types of operational tasks, referred to in Appendix 2.5-1/A as Microlog and Microtac. The Microlog provided a way in which to measure the transportability of each POMMS. The Microtac provided a measure of the transportability independent of system variability and dependent on Module performance.

Although Module reaction to the transportability characteristics of each of the POMMS was generally unfavorable, no opportunity for preference of a mechanized system was afforded by the scope of this experiment. Selection of other means of dismounted movement was limited by training time. This accounted primarily for the restriction against skis. However, the use of skis, even with trained Modules, would have limited transportability with sleds.

Although the cartridge belt was provided in the basic system plan, it was excluded because it was found to be incompatible with the clothing ensemble.

The intrenching tool proved to be a useless item. The shovel portion is not compatible for effective handling of the natural materials of construction in the area of the experiment - snow, varying from 0.3 to 0.9 in density.

The rucksack was considered adequate for QM polar requirements. The rucksack loads averaged 42 pounds.

Trail snowshoes would have been more effective than the bearpaw snowshoes which were used. The texture of the snow was such that movement on trail snowshoes during Microlog and Microtac tasks would have been accomplished more rapidly.

A pyrotechnic device should be included as an essential item of operational equipment in Greenland. Whiteout conditions arise so quickly without notice that small groups may become lost or be isolated only a short distance from a base area. The signal flares provide visibility through whiteouts for distances up to one-half mile.

3.3 MODULE PERFORMANCE

3.3.1 Module-Element Allocation

With the military personnel provided, each of the groups was organized into identical rank-oriented Modules composed of 1 officer, 1 noncommissioned officer, and 4 enlisted men (ranks Private or PFC, and 1 Corporal. The allocation of individual characteristics (officers excepted) and organization of the groups are shown in Table 3.3.1-1. The average characteristics of Module elements are given in Table 3.3.1-2.

3.3.2 Characteristics of the Module Elements

Substantive findings regarding materiel observed during the operation may be weighted by consideration of who participated in the experiments. The 18 men taking part as elements in the Module activities had aggregate personal characteristics which may not have been altogether typical. Insofar as the sample Modules may not be typical of other Army units at any instant of time, their response to use and acceptance of materiel may also be unrepresentative of general findings with wider sampling. Possible relationships between user characteristics and user reports were examined. The following gives a brief picture of the Module elements.

3.3.2.1 Background characteristics

Generally the men were young, averaging about 22 years. The officers and NCO's averaged 26 years, the 11 Privates and PFC's averaged about 20 years. They came from large families - the average number of living brothers and sisters they claimed was $3\frac{1}{2}$ which is about 2 more than the

Table 3.3.1-1 - Organization and Allocation of Module-Element Characteristics[a]

Characteristics						Allocation					
Subject						First Cycle Modules			Second Cycle Modules		
Code	MOS	Educ. Level	Age	Height	Weight	Alpha	Bravo	Charlie	Delta	Echo	Foxtrot*
Bt	540.00	12	24	65	165	x					
Bo	540.00	8	23	68	154		x			f	
Mp	006.00	10	19	70	190			x	x		
Mr	120.00	12	19	73	186			x		e	
Sh	550.00	12	22	71	148		x			x	
Sl	120.00	12	19	66	130			x		x	
Nw	122.00	10	23	71	180	x			x		
Wb	550.00	12	18	72	165		x		x		
Cy	542.60	12	35	66	150		x				
Gr	716.60	12	30	70	154	x				x	
Bg	542.60	10	28	71	160			b			
Ir	540.00	10	19	67	166	x				x	
Hb	540.00	11	20	70	150	x			x		
Mo	540.00	12	18	69	160		x		c		
Dv	540.00	10	18	70	140			x	d		

NOTES:
a. Table does not include characteristics of Module leaders (Officer personnel).
b. Subject removed for medical reasons, day 4, period 1.
c. Subject removed for medical reasons, day 3, period 4.
d. Subject replacement for c, Day 4, period 4.
e. Subject removed for medical reasons, day 3, period 4.
f. Subject replacement for e, day 4, period 4.
*. Module Task Team not formed due to limitation of personnel available.

Table 3.3.1-2 - Average of Module-Element Characteristics

	Alpha	Bravo	Charlie	Delta	Echo
Age (years)	23.2	23.2	20.6	19.6	22.0
Height (inches)	68.6	69.2	70.0	70.3	69.2
Weight (pounds)	163.0	153.4	161.2	164.2	156.2
Educational level (year)	11.0	11.2	10.8	10.8	11.0

national United States average as of the 1959 record[1]. None of the men was an "only" child. Their age positions in the family were about as would be expected on a chance basis.

A nice urban-rural balance was struck among the test subjects; half lived mostly in cities before age 16, half lived mostly in small towns or in the country. Fourteen home states were named. The 3 officers were college graduates; the enlisted men averaged 10½ school years, all of them having had at least 8 years and not more than 12 years of schooling. The distribution of fathers' occupations was similar to that based on national figures[1], except there were more service workers and farmers than average, and no clerical and sales workers.

Attitudes of test subjects toward the operation and their fellow participants varied. Asked in the pre-operation questionnaire item 1 (see Appendix 2.7-1/A) to check reasons for volunteering for the operation, 4 Module elements stated that they did not volunteer, and many of the others implied that they "did not exactly volunteer." However, they still answered the question, indicating the kind of interest they had in the operation. Reasons checked were: outdoor life - 5; scientific interest - 4; good fellowship - 0; personal challenge - 5; plain curiosity - 4; duty and promotion, other personal benefit (such as overseas credit) - 7; some other reason - 1. It may be seen that practical and expedient reasons were at least as salient as reasons of intellectual, emotional, or social interest and satisfaction. Similarly, in response to pre-questionnaire item 2 (on participants' level of interest and desire toward going out on the Ice Cap) we find less than the whole-hearted eagerness which might be expected from true volunteers. Responses were: very high interest - 7; rather high interest - 3; and low or only moderate interest - 8.

3.3.2.2 Social Attributes

In addition to providing background data, subjects were asked in the pre-operation questionnaire to name those among their colleagues who were

[1] Communication from Librarian, Department of Commerce, Bureau of Census, Chicago, Illinois, 1959.

notable in terms of a number of attributes. Data resulting are shown in Table 3.3.2-1. For reasons of social control, the 3 commissioned officers were excluded from these peer ratings on a number of the attributes investigated. Also, in Table 3.3.2-1, the numbers of persons mentioned on an item do not always add up to 18 times the number of "mentions" asked for, because some Module elements failed to answer some questions completely.

Table 3.3.2-1 - Frequency of Peer-citations of Participants for Various Attributes* (included in Pre-operation Questionnaire Items)

Code Name	Rank	Item Nr. in Pre-operation Questionnaire**										
		3	4	5a	5b	6a	6b	7a	7b	8	9a	9b
Ft	2d Lt	*	6	*	*	*	*	*	*	*	7	0
Cm	2d Lt	*	1	*	*	*	*	*	*	*	3	3
Hr	2d Lt	*	6	*	*	*	*	*	*	*	4	2
Bg	SFC	8	10	10	1	7	1	0	7	9	8	1
Gr	SFC	6	1	3	0	7	1	3	1	2	0	3
Cy	SFC	10	3	6	1	4	1	2	0	2	2	9
Nw	Cpl	11	6	12	3	6	5	0	13	7	7	4
Bo	PFC	3	3	2	8	4	7	7	1	4	2	1
Ir	PFC	3	6	3	5	7	4	10	2	4	3	5
Mp	PFC	5	6	12	2	5	5	3	9	7	6	3
Mr	PFC	3	4	3	7	3	8	4	8	3	4	3
Sh	PFC	2	4	2	5	6	5	15	0	4	2	4
Sl	PFC	9	12	6	1	9	1	2	5	12	9	2
Wb	PFC	0	2	0	12	2	8	7	3	1	1	9
Bt	Pvt	3	3	2	2	3	6	1	5	3	3	6
Dv	Pvt	4	8	4	8	5	4	0	16	10	5	7
Hb	Pvt	2	2	0	3	1	3	8	0	0	0	2
Mn	Pvt	2	6	2	10	3	7	9	1	3	1	7
		71	89	67	68	72	66	71	71	71	67	71

*Commissioned Officers excluded.

** Description of Items:

Item 3 : Name 4 most observant and critical judges

Item 4 : Name 5 preferred team members

Item 5a: Name 4 expected to perform well

Item 5b: Name 4 not expected to perform well

Item 6a: Name 4 who may be more considerate

Item 6b: Name 4 who may be less considerate

Item 7a: Name 4 who are most quiet

Item 7b: Name 4 who are most talkative

Item 8 : Name 4 who are likely to become popular

Item 9a: Name 4 most similar to self

Item 9b: Name 4 least similar to self

Inspection of Table 3.3.2-1 shows that there were distinct differences between Module elements, and suggests that these differences fall into patterns. For example, the 3 Module elements receiving the most votes as likely to be good performers (item 5) are also among those named most often as being talkative (item 7). This suggests that "quiet ones," low in social saliency, are unlikely to receive votes of confidence on their performance potential; the 5 Module elements named as most quiet on item 7 received only 9 nominations as being "good" expected performers and 43 nominations as being "poor" expected performers. Paragraph 3.3.5 will discuss the accuracy of these peer estimates of performance.

Table 3.3.2-1 also suggests that sociometric choice as a Module member is tantamount to a popularity vote (_vide_ the rank correlation of 0.77 between the distributions on items 4 and 8). Again, apparently test subjects like to think of _themselves_ as popular; this is suggested by rank correlations, between the item 8 distribution (on "popularity") and the item 9 distributions (on "similarity" and "dissimilarity" to self) of 0.73 and -0.25 respectively.

The meaning of these rank correlations (Kendall's _tau_) can be illustrated by reference to items 5, 6, and 7. Each of these items requests nominations both on a trait and its opposite. Frequency distributions of the 2 parts of each item should correlate inversely, e.g., the more the man is named as quiet, the less frequently one would expect that he be named talkative. These "split-half" correlations (_tau_) were -0.37 for item 5, -0.53 for item 6, and -0.53 for item 7. In terms of these empirical correlations of traits and their opposites, an observed _tau_ of 0.73 would appear to represent a high degree of relationship. When _N_ is greater than 10, _tau_ is about normally distributed. When based on all 18 Module elements, a value of 0.34 for _tau_ is significant at the 5 percent level; when _N_ = 15, a _tau_ of 0.38 is significant; and when _N_ = 11, a _tau_ of 0.43 is significant.

Further inter-correlation of frequency distributions also included (a) "talkativeness" nominations (item 7b) which correlated 0.43 and 0.47 with distributions on item 4 ("good performers") and item 8 ("popular"), respectively; and (b) "considerateness" nominations (item 6a) which correlated 0.49, 0.54, and 0.48 with distributions on items 4, 8, and 9a ("similar to self"), respectively.

3.3.2.3 Edwards Personal Preference Schedule Attributes (EPPS)

Participants were asked to complete the 225-item Edwards Personal Preference Schedule. Each item on this scale requires the test subjects to choose between 2 statements according to which is more characteristic of himself. The statements are chosen to describe certain supposed basic personality need-traits. There are 15 need-traits described by the 225 statements. Each of the 15 statements describing each need is compared with 2 of the 15 statements describing each of the other 14 needs;

thus, among 210 items each need is compared twice with each other need. The maximum score of statement choices which a person could give to 1 need-trait is 28 and the minimum is 0. An additional 15 pairs of statements are duplicated among the total of 225 as a check on test subjects' reliability.

Table 3.3.2-2 shows the individual scores of 14 of the 18 Module elements on each of the 15 traits measured by the EPPS. Scores of 4 of the Module elements (Nw, Ir, Mp and Mn) are omitted due to their low reliability indices. The traits are informally described at the base of the table. Average scores of the 14-man group are compared against 2 sets of standard scores, 1 for college men and the other for the general adult male population. Split-half reliabilities of the trait scores are provided in the first row of the table; that these reliabilities average lower than reliabilities observed in the standard populations for the test can be attributed in part to the relative homogeneity of this group of subjects.

Compared with the standardized "college" or "adult" males, the test subjects tended to average high on such "masculine" traits as aggression, sexuality, liking for change and achievement; and they averaged low on such "feminine" traits as succorance, introception, abasement, nurturance, and affiliation (the terms "masculine" and "feminine" here are meant to imply American stereotypes). In some instances a "youth" factor seems to be operating (as, for example, in the high scores for sexuality and achievement), while a "military" factor may account for the scores obtained on deference, orderliness, and autonomy. The test group was like the typical US male population, and unlike college men, in their scores for endeavor, introception, and orderliness; they were more like college men and less like the general male population in sexuality, liking for change, and low tendency to abasement. They were most homogeneous in their low "friendliness" (affiliation) and average deference scores, and they displayed the widest range of scores on such traits as need for autonomy, orderliness, and sexuality. As is to be expected, trait score reliability measures were generally highest for those traits for which most interpersonal diversity of scores was observed.

The distribution of scores in Table 3.3.2-2 varies with each of the EPPS dimensions. Note, for example, how the scores pile up on the upper half of the "HET" distribution and on the lower half of the "AUT" distribution. The 3 officers are clustered at the bottom of the nurturance (NUR) distribution and the 3 sergeants are at the top. In this connection, data for item 6 of the pre-questionnaire in Table 3.3.2-1 show that the sergeants were viewed by their men as high in "considerateness." On the other hand, Table 3.3.2-2 shows that the lieutenants were high in EPPS dominance and the sergeants were low on this trait. These findings may relate to the different leadership jobs these two ranks usually perform.

An interesting systematic relationship appears between peer ratings of performance potential (pre-questionnaire items 3 and 5 in Table 3.3.2-1) and the EPPS need for achievement. The higher the subject's ranking for performance potential in terms of summed nominations on both these items, the lower his reported achievement need (tau = -0.60; N = 11). This evidence conforms to well-established findings that low performers tend to inflate their achievement expectations, with resulting increased discrepancy between their self-expectancies and their abilities.

The other EPPS traits, (e.g., endurance, abasement, introception, succorance, affiliation, autonomy) generally do not relate closely to peer rankings and other evidences gained in the pre-questionnaire. This negative evidence suggests that the social attributes investigated in the pre-questionnaire are relatively independent of these listed traits. The latter may be more "personal" or individual, less directly "interpersonal" and social, and accordingly less related to the attributes measured in the pre-questionnaire.

3.3.3 Information from Module Elements

One of the best ways to find out about a product is to ask the man who has used it. For this reason, comments by participants on items of materiel were an important data source.

3.3.3.1 Diary Comment Production

The chief vehicle for comments on materiel was the diary form completed three times weekly. More than 800 comments on materiel were provided by Module elements on these forms during the 6 periods of the experiment. The data in Table 3.3.3-1 show that about twice as many diary comments were provided in the first week of operation as were provided during later weeks; indeed, more than a third of all diary comments were made during the first week. With 1 exception, the rate of diary comment production of all 14 elements taking part in both cycles dropped during the second cycle. This was to be expected, since the Module elements were instructed not to repeat comments after the first week if subjective reaction was unchanged. On an average, each of the 18 elements taking part in the operation submitted 13.6 diaries which included 48.4 comments (average: 3.5 comments per man per diary). However, as may be seen in Table 3.3.3-1, this average was made up of individual averages ranging from 1.47 comments per diary made by Mn to 7.82 comments per diary made by Sh. Almost 50 percent of all comments about materiel came from just 4 men. The top third of the men averaged 6.33 comments per diary, the bottom third averaged 1.91. These differences are partly reflected in the Module averages.

Table 3.3.2-2 - Reliabilities, Individual Scores and Means of Edwards Personal Preference Schedule Needs* as Measured Among 14 of the 19 Participants

Reliabilities:		Ach .62	Def .15	Ord .88	Exh .53	Aut .77	Aff .35	Int .85	Suc .81	Dom .87	Aba .59	Nur .45	Chg .61	End .52	Het .82	Agg .72
Dv	Pvt	15	11	6	18	12	9	15	3	25	16	8	13	19	28	12
Wb	PFC	20	10	12	12	14	9	13	13	12	8	15	24	13	27	8
Cy	SFC	12	15	22	13	12	9	15	11	17	8	17	19	18	10	12
Mr	PFC	20	9	8	15	21	8	10	3	17	9	10	19	11	27	23
Bg	SFC	10	12	18	19	8	15	10	15	9	6	18	19	15	24	12
Bt	Pvt	22	10	19	10	9	10	7	10	19	15	12	10	17	25	15
Bo	PFC	18	18	17	8	16	10	11	14	10	14	12	17	15	16	14
Hb	Pvt	15	9	6	9	14	15	13	7	10	21	16	22	15	19	19
Ft	2d Lt	17	19	14	15	5	7	10	11	22	6	5	18	25	16	20
Gr	SFC	17	10	16	14	18	6	9	6	13	13	15	16	18	20	19
Sl	PFC	14	14	12	13	23	14	13	8	14	20	11	14	13	21	6
Cm	2d Lt	14	17	16	19	5	12	15	13	20	11	8	9	10	23	18
Hr	2d Lt	19	12	15	17	14	8	24	4	20	13	6	22	10	15	11
SH	PFC	18	12	17	8	3	11	16	9	8	7	11	10	25	13	7
Range of scores		12	10	18	11	20	9	17	12	16	15	13	15	15	18	16
Mean score		16.4	12.4	14.1	13.6	8.9	11.5	12.9	9.0	15.4	11.9	11.7	15.8	16.0	20.3	14.0
Standardized scores:																
College men		15.7	11.2	10.2	14.4	14.3	15.0	16.1	10.7	17.4	12.2	14.0	15.5	12.7	17.8	12.8
General male population		14.8	12.2	14.7	12.7	14.0	14.5	14.2	10.8	14.5	14.6	15.7	13.9	17.0	11.2	13.0

*Needs:

Ach - Achievement: tendency to persevere in difficult tasks; to obtain recognition for ability.
Def - Deference: tendency to follow others, to support leaders and let them make the decisions.
Ord - Orderliness: tendency to plan, to organize, to schedule, to pigeonhole, to categorize.

(continued next page)

Table 3.3.2-2 (cont)

Exh - Exhibitionism: tendency to seek to attract attention, to brag, to show off, to be smart and witty.

Aut - Autonomy: tendency to remain detached, beholden to no man, independent, anti-organization, anti-conformity.

Aff - Affiliation: tendency to seek friends, to seek to keep friends, to write to them, to visit them, to be loyal to them.

Int - Introception: tendency to psychologize self and others, to study attitudes and values of self and others.

Suc - Succorance: tendency to seek aid and comfort from others, to shift one's troubles on to others.

Dom - Dominance: tendency to win arguments, to organize people, to like to take leadership.

Aba - Abasement: tendency to be timid, to avoid disagreement, to feel guilty and inferior, to punish self.

Nur - Nurturance: tendency to forgive others, to be generous, kind, helpful, affectionate, and sympathetic.

Chg - Change: tendency to seek novelty, fads, to experiment, to wander, to travel, to be bored with routine.

End - Endurance: tendency to stick-to-itiveness, perseverance, prolonged application to lone tasks.

Het - Heterosexuality: tendency to seek physical and romantic love, and to think, read, and talk about it.

Agg - Aggression: tendency to blame others, get revenge, degrade others, like violence, to talk back and criticize.

Table 3.3.3-1 - Diary Comments on Materiel Tabulated by Subject, Module, and Cycle

Code Name	1st Cycle Module	1st Cycle No. of Comments	1st Cycle No. of Diaries	1st Cycle Avg.	2d Cycle Module	2d Cycle No. of Comments	2d Cycle No. of Diaries	2d Cycle Avg.	1st and 2d Cycles No. of Comments	1st and 2d Cycles No. of Diaries	1st and 2d Cycles Avg.	Rank
Ft	Alpha	39	8	4.88	Echo	-	-	-	39	8	4.88	5
Gr	Alpha	35	8	4.38	Echo	29	9	3.22	64	17	3.76	7
Ir	Alpha	28	8	3.50	Delta	15	9	1.66	43	17	2.53	11
Nw	Alpha	30	8	3.75	Delta	69	9	7.66	99	17	5.82	4
Hb	Alpha	16	8	2.00	Delta	21	9	2.33	37	17	2.18	13
Bt	Alpha	54	8	6.75		-	-	-	54	8	6.75	3
Total	Alpha	202	48	4.21								
Cm	Bravo	74	8	9.25	Echo	41	9	4.55	115	17	6.76	2
Cy	Bravo	35	8	4.38	-	-	-	-	35	8	4.38	6
Sh	Bravo	86	8	10.75	Echo	47	9	5.22	133	17	7.82	1
Mn	Bravo	20	8	2.50	Delta	2	3	0.67	22	11	2.00	15
Wb	Bravo	31	8	3.88	Delta	7	9	0.77	38	17	2.23	12
Bo	Bravo	15	8	1.88	Echo	7	7	1.00	22	15	1.47	18
Total	Bravo	261	48	5.44								
Hr	Charlie	27	8	3.38	Delta	17	9	1.88	44	17	2.59	10
Bg	Charlie	9	3	3.00	-	-	-	-	9	3	3.00	8
Sl	Charlie	15	8	1.88	Echo	17	9	1.88	32	17	1.88	16½
Dv	Charlie	21	8	2.63	Delta	8	6	1.25	29	14	2.07	14
Mp	Charlie	27	8	3.38	Delta	5	9	0.55	32	17	1.88	16½
Mr	Charlie	22	8	2.75	Echo	3	1	3.00	25	9	2.77	9
Total					Echo	159	53	3.00				
	Charlie	121	43	2.81	Delta	129	54	2.39				
Grand Total									872	246	3.54	
	Alpha, Bravo & Charlie	584	139	4.20	Echo & Delta	288	107	2.69				

3.3.3.2 High-Low Comment Producers

Few differences were found in the characteristics of high producers of information as contrasted with the characteristics of low producers. The most obvious characteristic of the highest producers was that they included 6 of the 7 officers and NCO's. Accordingly, the age and education factors were also related to comment productivity. When officers and NCO's are eliminated, the average age of the 5 higher producers (20.4) differs only very slightly from that of the remaining 6 (19.3). When the 3 officers are eliminated, the education variable is unrelated to military rank; it does, however, retain a slight positive relationship to the comment-production variable. The urban-rural variable also seemed to bear a slight relationship to comment production, with the urban men tending to make more comments. Analysis of a joint classification of test subjects as high, medium, or low comment producers and as urban or rural in origin shows that the relationship borders on significance.

There was no evidence that the reasons men checked for volunteering were related to their propensity to comment about materiel. However, their "level of interest" in the operation was related to comment production (Table 3.3.3-2). The level of interest to officers and NCO's is higher than that of privates and PFC's on the average, and this accounts for much of the observed relationship of interest to productivity; however, even when this variable is controlled, the relationship remains to some degree. The enlisted participants were asked to state who among them would make the most observant and critical judges. When rankings of NCO's are eliminated, nominations for "observant and critical judge" appear to bear a negative relation, if any, to comment productivity.

Scores of the 15 Edwards Personal Preference Schedule traits were reviewed to ascertain whether any of them could differentiate high comment producers from low producers. As noted in paragraph 3.3.2.3, these scores were available only for those 14 of the 18 Module elements whose responses adequately met reliability criteria. Only 1 of the EPPS traits related to comment productivity at a statistically significant level. This was autonomy, defined as "the tendency to remain detached, uninvolved, beholden to no man, independent, anti-organization and anti-conformity." Scores on this trait were inversely correlated with military grade, which partly accounts for the relatively high negative rank correlation ($tau = -0.56$) between it and diary comment productivity. Also, as expected, those high on autonomy had a lower level of interest in participating in Ice Cap operations than did persons low on autonomy ($r = -0.54$).

The generality of the index of information productivity used in the above comparisons may be questioned. For example, on another occasion with a different set of topics or with a different type of data medium than the diaries, would the pattern of differential productivity among Module elements have been the same? In other words, is high response

productivity a general trait of some Module elements, as the preceding analysis implies, or is it mainly a function of the circumstances under which responses are obtained?

Table 3.3.3-2 - Relation of Level of Interest in Greenland Ice Cap Operation to Diary Comment Productivity

Code Name	Rank Order of Productivity	Level of Interest
Sh	1	6
Cm	2	4*
Bt	3	7
Nw	4	6*
Ft	5	6*
Cy	6	6*
Gr	7	6*
Bg	8	5
Mr	9	4
Hr	10	5*
Ir	11	4
Wb	12	3
Hb	13	5
Dv	14	4
Mn	15	4
Sl	16	2
Mp	17	6
Bo	18	4

Kendall's tau = 0.50 (significant at $<$ .01 level)

*Score of Officer or NCO

Some evidence on these questions may be found from another data-collection instrument used during the operation, the General Information Questionnaire (see Appendix 2.7-1/A). A number of its items (1, 2, 4, 6, 10, and 14) concerned operational details. Resulting data were for the most part scanty; for example, only 21 replies to item 6 ("errors and mistakes") were obtained from the total of about 90 questionnaires completed during the 6 weeks of the operation. However, on item 10 (pleasant and unpleasant aspects of duties) there were 193 comments. The frequency of responses to item 10 made during the first 3-week cycle by the 12 Module elements taking part in both cycles was compared to the frequency of responses of these same subjects to the item during the second cycle. The product moment correlation was 0.89. The similar intercycle correlation, run on the summed frequency of comments of these same subjects in response to other open-ended questions (items 1, 2, and 4) was 0.93. Thus, for at least 2 different sets of questions, the different personal tendencies to respond appear very stable over successive cycles of the operation.

Another measure of the stability of the response tendencies of Module elements is correlation of individual response frequencies over different sets of questions. The total of responses to the General Information Questionnaire items 1, 2, and 4 made by each of 17 Module elements participating throughout the first cycle was correlated with their response frequency to item 10; the resulting r was 0.72. This figure is quite high in view of the variation in stimulus items considered - one could reasonably expect subjects to vary considerably in responsiveness as questions are varied. A similar comparison between the Module elements' diary comment output during the first cycle and their first-cycle questionnaire output frequency summed over items 1, 2, 4, and 10 gave a correlation of 0.66. Despite differences in question topics and in response vehicles (diaries or questionnaires), there was a consistent tendency for some Module elements to feed back more subjective information than others.

3.3.3.3 Participant-Observer Performance

Another measure of participant performance is the mean level of preference ratings assigned by the participants to the items included in the different POMMS. Here interest will be directed towards food data and the average level of food ratings will be discussed. Substantive data pertaining to the specific rations are presented in paragraph 3.2.4. The levels of average food ratings are shown in Table 3.3.3-3.

Table 3.3.3-3 - Level of Average Food Ratings of Module Elements

		Average Food Rating	
Code Name	Rank	1st Cycle	2d Cycle
Ft	Lt	7.7	*
Cy	SFC	7.7	*
Bo	PFC	7.4	7.2
Mr	PFC	7.2	*
Cm	Lt	7.1	7.6
Mp	PFC	7.1	7.4
Sh	PFC	6.9	7.5
Bg	SFC	6.8**	*
Nw	Cpl	6.6	7.0
Hb	Pvt	6.4	6.1
Mn	Pvt	6.4	7.6
Sl	PFC	6.4	6.8
Ir	PFC	6.2	7.5
Bt	Pvt	6.0	*
Gr	SFC	6.0	6.9
Dv	Pvt	6.0	6.8
Hr	Lt	6.0	6.7
Wb	PFC	5.8	6.4

*Did not participate during 2d cycle
** Removed after 3 days participation

On the average, foods were rated about 0.5 scale points higher during the second cycle than during the first (Bo and Hb were exceptions). The increase in mean level of ratings was greater for Module elements who rated foods low during the first cycle, as is to be expected through typical regression. Accordingly, inter-individual variance in mean level of food ratings was reduced during the second cycle, although the inter-cycle correlation of levels of individual average ratings is +0.55.

Comment-productivity rankings were compared with first cycle data in Table 3.3.3-3. The rank correlations were low, although the X^2 contingency value (5.55) for subjects above and below the medians (of productivity and of level of food ratings) was significant at the 0.05 level. In view of this low relationship, it is to be expected that variables previously reported as relating to diary comment productivity would not particularly relate to "liberality" of food ratings. The image of the comment-productive participant emerging in the preceding section was that of the less autonomous person, of higher rank and more task-oriented. Cutting across this picture of the high producer are lines delineating the more generous from the less generous raters. Most clearcut is the EPPS deference dimension, as shown in Table 3.3.2-2 (page 70); the more "other-directed" (deferent) among the Module elements tend to rate the rations more liberally. Kendall's *tau* for this relationship is +0.55. The relationship persists when only privates and PFC's are considered, but it clearly is related to the rank of participants, as officers and noncoms tend to be more deferent. As shown in Table 3.3.2-2, the same officers and noncoms also tended to admit to the EPPS succorance need, so this variable is slightly correlated to subjects' average level of food ratings (tau = 0.26). Since officers and noncoms averaged higher ratings and are older, the *tau* for the rating level vs. age correlation was 0.29. Due to association with age, the EPPS heterosexuality dimension also bears a slight relationship (*tau* = -0.32) to level of ratings. Aside from these and other relationships with attributes associated with rank, however, the elements' levels of food ratings seemed relatively independent of personal characteristic except EPPS deference.

3.3.3.4 Variance of Ratings

This section can be concluded with consideration of the variance of Module elements' ratings. A 7-point rating scale was provided, which Module elements used to rate the verity of certain statements about their groups. There were 20 such statements which appeared as item 12 of the General Information Questionnaire (Table 3.3.4-1, page 79). The least sensitive respondents largely restricted themselves to using 2 of the 7 response categories of the scale to express their views of the truth or falsehood of the statements. More sensitive respondents, on the other hand, used all 7 of the scale categories. Presumably respondents in the latter group were using subtle judgment in discriminating between the relative truth of alternatives. On the other hand, respondents restricting

themselves mainly to just 2 contrasting scale categories would appear to be using a crude "go, no-go" dichotomy. The tendency to see things in terms of blacks and whites instead of greys is associated with the concepts of rigidity and dogmatism. It also presumably is a correlate of intelligence. In terms of information theory, such effective reduction of a rating scale into a binary classification system by respondents reduces the amount of information they can provide.

A simple measure of respondent rating sensitivity is the proportion of their ratings of the 20 statements which are restricted to their 2 most frequently used categories. Seventeen subjects completed the 20-statement classification task twice, making a total of 40 ratings, during the first 3-week cycle. The number of these ratings which fell into each person's 2 most frequently used categories is shown in Table 3.3.3-4.

Table 3.3.3-4 - Number of Ratings of the Statements in General Information Questionnaire Item 12 which fell into Each Element's 2 Most Frequently Used Categories

Code Name	Rank	Number of Ratings
Bt	Pvt	37
Mn	Pvt	36
Hb	Pvt	29
Sh	PFC	28
Mr	PFC	27
Mp	PFC	27
Bo	PFC	26
Ir	PFC	26
Cy	SFC	26
Sl	PFC	25
Nw	Cpl	24
Gr	SFC	24
Ft	Lt	23
Cm	Lt	23
Dv	Pvt	22
Hr	Lt	21
Wb	PFC	20

Inspection of the table shows that, at one extreme, Bt classified about 9 out of 10 statements in just 2 of the rating scale categories, while at the other extreme Wb classified only half the statements in his 2 favorite categories. The ordering of the subjects in terms of this response index was compared to that obtaining on the pre-operation measures (paragraph 3.3.2) and the 2 measures of observer performance discussed earlier. Very little in the way of systematic relationships emerged. Apparently military ranks of the elements are associated with

their ability to provide sensitive ratings, as the 3 officers fell among the top ranks on rating variability and the lowest position among the NCO's was tenth place. Average frequencies by rank were: four privates, 31; seven PFC's, 25½; four noncoms, 25; and three officers, 22.

This relationship of the rater sensitivity measure to military rank implies that other correlates of rank will relate to the measure. Even when only privates and PFC's are considered, a moderate positive correlation between rater sensitivity and "saliency" (frequency of nomination on pre-questionnaire item 8) appears (<u>tau</u> = 0.36). On the other hand, although level-of-interest (item 2 on the pre-questionnaire) was found correlated with rank and therefore would presumably correlate positively with rater sensitivity, among the 11 privates and PFC's the opposite holds: a negative correlation (<u>tau</u> = -0.56) between level-of-interest and sensitivity scores is obtained.

Low expressed interest is just about the only common attribute the 2 "most sensitive" EM appear to share. They differ considerably on most other attributes. None of the 15 EPPS scores show any relationship to the sensitivity rankings, although it had been expected that a relationship would exist for <u>autonomy</u> or <u>introception</u>. Equally notable is the absence of any definite relationship between the sensitivity measure and the other 2 measures of observer performance. For example, the 4 lowest ranking individuals in terms of level of food ratings are split up into the top and bottom extremes of the rating sensitivity distribution. The same radical shifting in position occurs between the comment-productivity rankings and the sensitivity rankings, except that here the privates and PFC's tend to be at the bottom of the distribution.

3.3.4 <u>Module-Element Morale</u>

The study of morale was central to the psychological, sociological phase of the operation for 2 reasons: first, because equipment evaluation depends partly on the user's motivation to use it properly and to give it a fair test; and second, because a "plus value" of any equipment system can be the way it may cause elements of the Module to work together well and to want to perform well for the common good of the unit. Attention was given to a number of questions in the weekly General Information Questionnaire which sought to determine individuals' degree of satisfaction with their situation and companionship. Morale and performance patterns in groups and possible effects of time and different POMMS on these patterns were also studied.

3.3.4.1 <u>Element Morale Determinations</u>

The weekly General Information Questionnaire item most directly aimed at morale measurement was an omnibus of 20 statements pertaining to the Module

of which the subject was an element. These occupied the third page of the questionnaire (see Table 3.3.4-1). Elements completed this item 4 times, once in each of the first 2 weeks of each cycle. In the third week of each cycle, a different page presenting items (13) to (16) together with a different item (12) was substituted.

Table 3.3.4-1 - Statements Used in General Information Questionnaire*

(1) Many in the group are afraid to say what they really think.

(2) Somebody is ready to give you a hand, even without your asking.

(3) Privileges are determined by rank.

(4) Although we are together at meal times, nobody says much.

(5) Everybody pulls together to get a job done.

(6) It doesn't take much to get an argument started in the group.

(7) This would be a better group if we could eliminate a few members.

(8) The group as a whole makes important decisions.

(9) Some of the group think only of themselves, even on matters that affect everybody.

(10) Members of the group work well together as a team.

(11) We do a lot of bitching.

(12) Some in the group do all the work and others take all the credit.

(13) Some or another of the guys is always rubbing somebody the wrong way.

(14) There is a pretty good feeling between us here.

(15) Some members of the group don't really know what they are here for.

(16) The group needs fewer chiefs and more Indians.

(17) Everyone in the group can have his way.

(18) Some of the men are shirking their duty.

(19) Not everyone has a clear idea of what he is supposed to be doing.

(20) I would rather be with my present group than with either of the other two groups.

*Thanks are due to Dr. Herbert Zimmer for his permission to select and modify certain statements from his GROUP BEHAVIOR DESCRIPTION (See: Zimmer, H. A Test Program for Two Antarctic Expeditions: 1956-1959. Final Report Contract NONR 1530(06), 15 Dec. 1959. Georgetown University Medical Center, Washington 7, D.C.)

These 20 statements imply what is meant by morale in this report. The concept is taken to include such meanings as satisfaction with Module performance, awareness of common purpose among group members, unwillingness to leave the group for another, and low dissatisfaction with other Module elements. These values are reflected among the statements, 13 of which are negatively toned and 7 of which are positively toned. Elements were asked to rate the level of accuracy with which each statement applied to their Modules. Low ratings of negatively toned statements are supposed to represent high morale. A net morale score is derived by subtracting the sum of the negative ratings from the sum of the positive ratings.

Data obtained on item 12 during both cycles are summarized in Tables 3.3.4-2 and 3.3.4-3. Table 3.3.4-2 shows the morale scores for each Module element each time he completed the questionnaire. Table 3.3.4-3 gives the average Module scores for the first 2 weeks of both cycles, also the variance for each Module. The latter was obtained by computing the variance for each statement, then averaging across statements.

Table 3.3.4-2 - Individual Net Morale Scores (Derived from General Information Questionnaire, Item 12, for the First 2 Weeks of Both Cycles)

	Morale Scores First Cycle		Morale Scores Second Cycle	
Subject	Week 1	Week 2	Week 1	Week 2
Ft	0	-36	*	*
Gr	17	-4	29	28
Nw	-29	-37	20	24
Hb	10	13	20	6
Ir	-6	10	23	25
Bt	-7	-10	*	*
Cm	9	6	14	10
Cy	19	9	*	*
Sh	19	20	29	34
Mn	-9	19	27	18
Wb	-1	6	12	11
Bo	-13	-8	-3	-1
Hr	11	6	15	15
Bg	21	**	*	*
Sl	-9	-13	-2	-5
Dv	20	-1	*	*
Mp	-8	-2	-6	0
Mr	6	-23	*	*

*Did not participate in second cycle.
**Dropped out after first week.

Table 3.3.4-3 - Average Module Morale Scores and Variances (Derived from General Information Questionnaire, Item 12, for the First 2 Periods of Both Cycles)

Cycle	Module	1st Period Average Score	1st Period Variance*	2d Period Average Score	2d Period Variance*
First	Alpha	-2.5	1.83	-11.0	1.76
	Bravo	4.0	1.25	8.7	1.19
	Charlie	6.5	1.28	-6.6	1.02
		4th Period		5th Period	
Second	Echo	15.4	1.27	14.6	1.10
	Delta	14.7	1.48	12.6	1.31

*Variances were computed separately for each question, then averaged over all 20 questions.

There were distinct differences between elements in terms of their expressed satisfaction with their Module situation. This is partly attributable to differences between Modules, but even within Modules the variation is considerable. In each of the Modules there were elements who awarded highly favorable net scores to their Modules, while other elements provided low scores. In line with their supportive roles, the 3 sergeants indicated high morale scores in their respective groups during the first period. Other background attributes possibly related to morale of individuals were urban-rural origin (higher morale scorers included more city boys) and number of siblings (higher morale scorers averaged one more than lower scorers). Surprisingly, none of the peer ratings shown in Table 3.3.2-1 (page 66) related even moderately with first-period morale scores.

Turning to the Edwards Personal Preference Scores shown in Table 3.3.2-3 (page 69) one may note first that the 4 elements (Ir, Mp, Mn, and Nw) for whom data are not tabulated due to unreliability all fall into the lower, negative end of the distribution of first-week morale scores. None of the EPPS indices related closely to the morale distribution of the first-week period, although when only privates and PFC's are considered, a mild negative relationship with <u>autonomy</u> (<u>tau</u> = -0.31) and a mild positive relationship with introception (tau = 0.48) can be noted. These few findings generally fall in line with established trends showing higher social morale among persons having backgrounds and attributes conducive to the acquisition of social sensitivity and skill.

The distribution of net morale scores during the first period can be compared with other measures produced concomitantly. Table 3.3.4-4

shows the number of comments produced in diary's Part I (concerning materiel) during the first week by "high" and "low" morale individuals. No systematic pattern appears; however, comments in response to the diary's Part II (concerning subjective and social experiences) were made more frequently by the 9 persons with positive morale scores. A check was made on the direction of the diary's Part II comments. Negative comments were relatively less frequent among the elements with higher morale scores.

Table 3.3.4-4 - Net Morale Scores in Relation to Number and Type of Diary Comments during the First Period of the First Cycle

Code Name	Net Morale Score	Number of Diary Comments Part I	Part II	Part II Negative	Code Name	Net Morale Score	Number of Diary Comments Part I	Part II	Part II Negative
Bg	21	9	3	3	Ft	0	24	14	7
Dv	20	12	14	14	Wb	-1	17	4	4
Sh	19	30	22	10	Ir	-6	19	13	13
Cy	19	23	0	0	Bt	-7	34	20	14
Gr	17	17	12	2	Mp	-8	15	0	0
Hr	11	13	14	7	Mn	-9	9	6	3
Hb	10	10	13	10	Sl	-9	6	5	5
Cm	9	34	13	4	Bo	-13	9	1	0
Mr	6	14	9	9	Nw	-29	20	4	4
		162	100	59			153	67	50

During the second week of the first cycle, a number of changes in morale scores took place. For example, while Nw remained strongly negative and Sh remained high, scores for Ft, Mr, Dv, and Gr dropped sharply during the second week and those for Mn and Ir rose. If these shifts imply positive and negative trends in morale, then an adjusted ranking can be made up reflecting a crude extrapolation of morale scores to the third week of the cycle. Under this ordering, elements with high scores during both weeks (++) or low scores during both weeks (--) would remain at the extremes, while those with upward score trends (-+) would precede those with negative trends (+-). If this ranking is then compared with comment production in the diary's Part I during the first cycle (Table 3.3.4-5), it is seen that elements in the lower half of the distribution provide less information about materiel and that their proportional decline from the first to the second week is greater.

However, this morale ranking does not appear to be related to level of average food ratings in the first cycle (see Table 3.3.3-3, page 75).

Apparently social morale, as reflected in the net morale scores, did not affect elements' pleasure in food (and vice versa).

Table 3.3.4-5 - Relation of Adjusted Morale Scores to First Cycle Comment Productivity in Part I of the Diary and Percent Decline in Production from Week 1 to Week 2

Code Name	Morale Score Rank	Total Comments	Percent Decline	Code Name	Morale Score Rank	Total Comments	Percent Decline
Sh	1	86	0.09	Dv	9	21	0.50
Cy	2	35	0.59	Gr	10	35	0.31
Hb	3	16	0.33	Mr	11	22	0.75
Hr	4	27	0.30	Ft	12	39	0.50
Cm	5	74	0.31	Mp	13	27	0.66
Wb	6	31	0.48	Bt	14	54	0.42
Mn	7	20	0.13	Bo	15	15	0.38
Ir	8	28	0.41	Sl	16	15	0.20
				Nw	17	30	0.82
Average		40	0.33			29	0.50

3.3.4.2 Module Morale

Among the 8 elements with higher (adjusted) morale scores in the first cycle, 5 are from Module Bravo, 1 is from Module Charlie, and 2 are from Module Alpha. Table 3.3.4-3 (page 81) shows how the average values from the Module change during the first cycle. With the exception of Module Bravo, average scores were lower during the second period. This finding is in line with the typical sociometric pattern, in that members of newly-formed groups over time become able to be more overtly critical. One rationale is that members become more assured of their evaluations of one another and less fearful that admission of criticism will lead to breakup of the group; also, of course, group members become partly disillusioned of their impressions of each other.

Both Modules in the second cycle had distinctly higher average morale than did the first-cycle Modules. This may be due partly to the removal of dissidents in forming the second-cycle Module; 3 of the 6 who were dropped (Ft, Bt, and Mr) had low net scores in the first cycle. All 12 of the second-cycle participants had higher scores than in the first cycle; the greatest increase, approximately 55 points, was recorded by Nw. It seems more likely that the higher scores in the second cycle reflect the men's growing confidence in their ability to cope with the environment and to coordinate their work more effectively. Thus the scores represent both realistic, objective appraisals of improved performance and the men's pleasure in realizing this increased effectiveness.

Table 3.3.4-3 shows higher morale scores for Module Bravo than for the other two Modules in the first cycle. With few exceptions, scores on negatively-toned items were lower, and increased less during the second week, than for the other two Modules in the first cycle. This was especially true for statements 9, 11, 13, 15, and 19, concerning structural clarity and misunderstandings.

The extent of the intra-group agreement on ratings of morale statements is shown by the variance figures in Table 3.3.4-3. For all 5 Modules, variances during the second period of the 2-period sequences are lower than those for the first period. Also, variances for Module Alpha, with the lowest morale scores, are greater than for the others. This may be ascribed to the extreme discontent of certain of its members (e.g., Ft, Nw).

Another way of comparing the 5 Modules is in terms of the structure of their working relationships and power relationships. Item 7 of the General Information Questionnaire required the participants each week to rank their Module elements in terms of "worked with most closely" and "least closely." Item 15 called for a ranking of each Module element at the end of each cycle in terms of the amount of weight and influence his opinions and ideas had in the Module. Data from these items are shown in Table 3.3.4-6.

Table 3.3.4-6 - Sums of Ranks Received by Elements of Each Module on General Information Questionnaire Items 7 ("Worked With Most Closely") and 15 ("Weight and Influence of Opinion")

	Item 7			Item 15	Item 7			Item 15	Item 7			Item 15
Weeks:	1	2	3	3	4	5	6	6	4	5	6	6
	Module Alpha				Module Echo				Module Delta			
Ft	6	15	13	8								
Gr	10	16	13	12	17	11	9	8				
Nw	14	14	15	13					11	13	13	7
Hb	18	16	14	18					17	13	11	14
Bt	18	17	18	15								
Ir	19	12	17	24	16	14	19	24				
	Module Bravo											
Cm	10	13	11	5*	10	10	11	6				
Cy	12	12	12	12								
Sh	16	14	12	14	13	20	16	21				
Mn	18	17	19	22					18	14	-	-
Wb	20	18	15	21					14	17	17	21
Bo	14	16	19	19	21	18	17	17				
	Module Charlie											
Hr	14*	12*	14*	9*					16	16	19	10
Bg	10	-	-	-								
Sl	19	10	12	12	13	17	18	14				
Dv	17	19	15	19					-	-	13	23
Mp	12	9	7	10					14	16	17	15
Mr	18	12	14	12								

*Corrected for omission of one person's rankings.
NOTE: The lower the sums, the more the items characterized the individual elements.

The groups show certain distinct differences in the <u>centrality</u> ("worked with most closely") and <u>power</u> ("weight and influence of ideas") patterns over time. Modules Bravo and Echo, both with high average morale scores, are led by a person (Cm) strong in centrality and power who maintains his position over time. His seconds-in-command, both sergeants, also maintain power and centrality or gain these over time. Then there is in each of these 2 Modules a third element with moderate power, while the remaining elements are consistently of low power. This pattern can be conceived of as a "star"; groups with this pattern are generally characterized by good performance but not always by the highest morale.

In the third of the 3 higher-morale groups (Module Delta), there is also a strong leader (Nw) who maintained his centrality over time. He was not the official Module leader but was second in command. The official leader in this group retained formal power but not informal centrality. This would appear to account for the open structure and free debate which ratings of item 12 statements indicate for this Module.

The 2 low-morale Modules (Alpha and Charlie) have leaders (Ft and Hr) unwilling or unable to maintain high centrality. Their seconds in command fail to take over the central position. This leads to a jockeying about for leadership in the case of Module Alpha, while in Module Charlie a PFC appears to have taken over working leadership and continued to "compete" with the same officer for secondary leadership in Module Delta.

The morale pattern of Modules appears to bear some relation to the quantity and nature of diary comment productivity previously discussed in terms of individuals (paragraph 3.3.3). Table 3.3.3-1 (page 72) shows that Modules Bravo and Echo, led by Cm, produced more comments than other Modules. Table 3.3.4-3 (page 81) shows the change in net morale scores from period 1 to period 2 for the Modules in the first cycle; a computation of the drop in diary comment production from period 1 to period 2, (Module Alpha had a 63 percent decline; Module Bravo, 46 percent; Module Charlie, 71 percent), roughly parallels the relative changes in the Modules' net morale scores.

Comments were further analyzed by Modules in terms of whether (a) they were made under the diary's Part I (concerning materiel and equipment) or Part II (concerning personal, physiological, and social experiences); and (b) if in the diary Part II, whether they were positive or negative in tone. Diary Part II comments in the first cycle were largely physiological, and <u>negatively</u>-toned, concerning thirst and tiredness. The few physiologic comments during the second cycle instead emphasized hunger and overheating, reflecting adaptation changes. However, Part II comments in the second cycle were mainly social and <u>positive</u>. Therefore, the lower-morale Modules in the first cycle should have produced a larger proportion of their total comments under diary

Part II, assuming negative comments are associated with lower morale. This proved to be true; the lower-morale Modules (Alpha and Charlie) had 65 percent and 59 percent of their total comments, respectively, in the diary Part II, while the higher-morale Module Bravo had only 40 percent in this area. Contrariwise, the lower-morale Module in the second cycle (Module Delta) should have produced a smaller proportion of their total comments under diary Part II, as compared with higher-morale Module Echo. This supposition also was confirmed by the data, Module Delta showing 49 percent and Module Charlie 63 percent.

When members of Modules Bravo and Echo made diary Part II comments, they should have been more positive than comments made by other teams, and these more favorable comments should refer more to group and social factors, and less to personal factors. Tabulations of the data (not shown here) generally supported this hypothesis.

The preceding evidence supports the argument that both the amount and the quantity of information provided by Module elements were a function of their Module morale. Members of the higher-morale Module provided more information, made fewer physiologic complaints, and were more likely to make positive comments about their Module.

The higher food ratings reported by Module elements in the second cycle have been noted in paragraph 3.3.3.4. Individual morale scores did not appear to be related to inter-individual differences in average level of food ratings. However, when these food ratings (Table 3.3.3-3, page 75) are arranged by Modules, the Module averages are: Alpha, 38.9; Bravo, 41.3; Charlie, 39.5; Delta, 40.9; and Echo, 43.5. These averages follow the pattern of average morale ratings for the groups.

3.3.5 Module-Element Performance

Three estimates were made of individual Module elements' performances. The first was made before the experimental period, when elements were asked to evaluate each other in terms of performance potential. The second was a series of ratings made by Module elements of each other's performance each period. The third was a post-operation ranking of all elements in terms of "total value contributed by the participant to the study." This ranking was made by each of 5 scientist-investigators.

Table 3.3.5-1 presents rankings on these 3 criteria. The men are listed in order of the average of 5 scientist-investigators' rankings. The second column shows the ranking derived from summing the frequencies with which enlisted men were mentioned on items 3 and 5 of the pre-operation questionnaire; these items concerned prediction of high performers in terms of observational skills and survival skills. Frequencies of nominations on these 2 predictor items were highly correlated (see paragraph 3.3.2). The third column gives rankings based on averaged ratings of each element by his peers for each week's performance

in the first cycle. Second-cycle ratings were too homogeneous to be useful for differentiating performances, probably because of high intra-group morale. Inspection of this table shows fairly good agreement between first-cycle operational rankings of mean performance ratings by peers and post-operational performance ratings by the investigators. Two points of disagreement were the rankings of the 2 lieutenants, Ft and Hr, who received higher evaluations from their followers than from the scientist-investigators; this is understandable because followers' down-grading their leaders would require overt acknowledgment that the leaders should be formally displaced.

Table 3.3.5-1 - Performance Rankings of Module Elements

	Scientist Investigators*	Peers Pre-operation**	Peers 1st Cycle***
Cm	1.0		2.5
Gr	2.0	6.0	1.0
Sl	3.0	5.0	8.0
Sh	4.0	12.0	13.5
Cy	5.0	2.5	13.5
Bo	6.0	12.0	5.5
Mp	7.0	4.0	5.5
Hb	8.0	12.0	2.5
Wb	9.0	15.0	10.0
Nw	10.0	1.0	9.0
Ft	11.0	9.0	5.5
Dv	12.0	9.0	16.0
Mr	13.5	10.0	11.5
Hr	13.5		5.5
Ir	15.0	8.0	11.5
Mn	16.0	14.0	15.0
Bt	17.0	7.0	17.0

*Average of post-operation rankings by 5 scientist-investigators.

**Based on summed frequencies of mentions on Items 3 and 5 of pre-operation questionnaire.

***Based on average performance rating of each Module element by peers in first cycle.

Prediction of scientist-investigators' rankings by the pre-operation questionnaire estimates was less satisfactory. However, recognition of the considerations of "saliency" brought out in paragraph 3.3.2.2, where the success of pre-operation estimates of popularity was discussed, serves to reduce the discrepancies. That is, here again Hb is under-estimated on the pre-questionnaire, as are Gr and Bo; these men were

infrequently mentioned on any trait in the pre-questionnaire. Discounting these "errors," there remain discrepancies for Sh and Nw. The latter can be qualified in that Nw received considerably higher performance ratings from his peers during the second cycle and, as we have seen, was the central person in his Module's work structure during the latter cycle. It would appear that where a person is sufficiently salient for his peers to be able to evaluate him, their estimate of his performance will contain a modicum of accuracy.

It is to be expected that the peer ratings of weekly performance will be colored by overtones of interpersonal effect; more popular teammates probably receive higher performance ratings. Popularity as measured by the ranking of average ratings received on General Information Questionnaire item 16 ("preferred teammates") was correlated with the ranking of elements in terms of performance ratings by their peers during the first cycle; the rank correlation resulting was 0.60 for the 17 Module elements for whom the data are available. Popularity also correlated with scientist-investigators' performance ratings at about the same level (0.52 for the 12 men completing both cycles). Scientist-investigator performance ratings were also compared to other attributes of the participants discussed in paragraphs 3.3.2.1 and 3.3.2.3. The one noteworthy correlation was between scientist-investigator performance ratings of elements, and the Edwards Personal Preference Schedule index of need for achievement (-0.51 for the 13 elements for whom the data were available). This negative relationship was previously noted in paragraph 3.3.2 with regard to pre-questionnaire performance estimates and is in accordance with findings reported in the literature. Inclusion of the need for achievement index in a predictor would not contribute much to successful performance prediction over that likely to result from consideration of pre-operation peer estimates alone. Inspection of Table 3.3.4-2 (EPPS scores, page 70) shows that persons low in saliency, and thus liable to peer underestimation of their potential performance, also tend to rank rather high in need for achievement.

3.4 ENVIRONMENT CLIMATE-SPACE-TIME INFLUENCE

The span of the experimental periods was scheduled for 26 July to 3 September 1959. The limitations of administrative and logistic support elements required that the start of the first experimental period be advanced to week of 19 July 1959 and the last period to week of 23 August.

The locations of the experimental stations were slightly altered from the original plan, to meet available construction capabilities.

The graphic presentations in Figures 3.4-1 thru 3.4-3 illustrate those climatic elements which most affected the conduct of Quartermaster research activities in the vicinity of Camp Fistclench from 19 July thru 27 August 1959. These data are based primarily upon hourly meteorological measurements by the Signal Corps Surface Observation Team at Camp Fistclench.

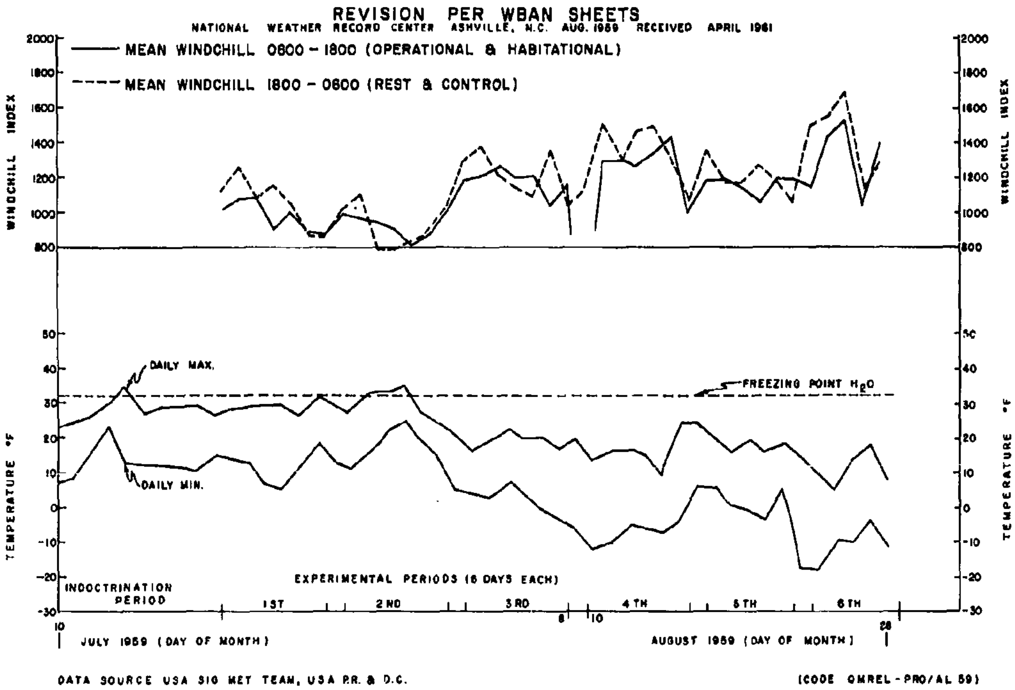

Figure 3.4-1 - Partial climatic time data for QM Polar Project 59-1 (Site II) Lat. 76°59'N - Long. 56°4'W. Altitude 7000 ft.

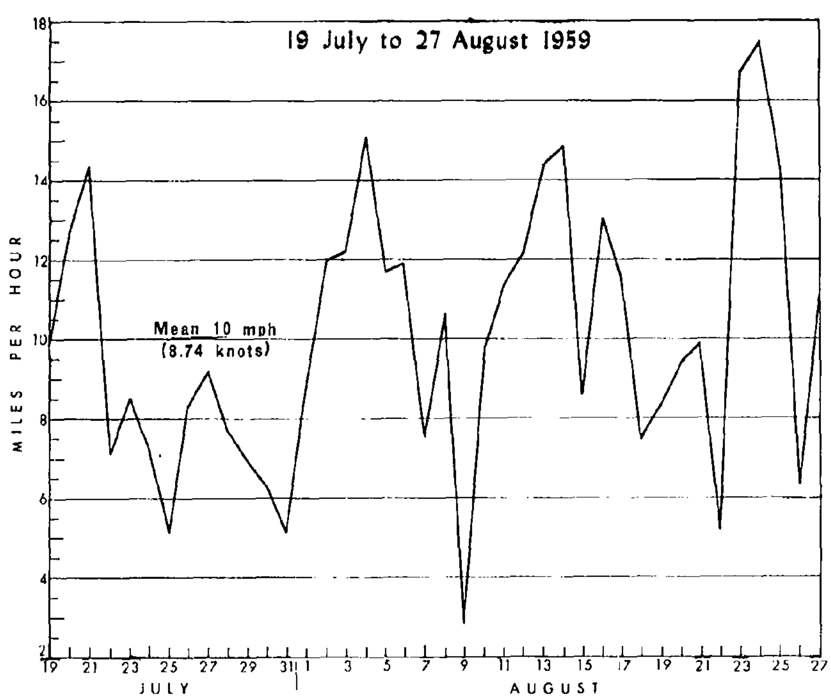

Figure 3.4-2 - Mean Windspeeds, Camp Fistclench

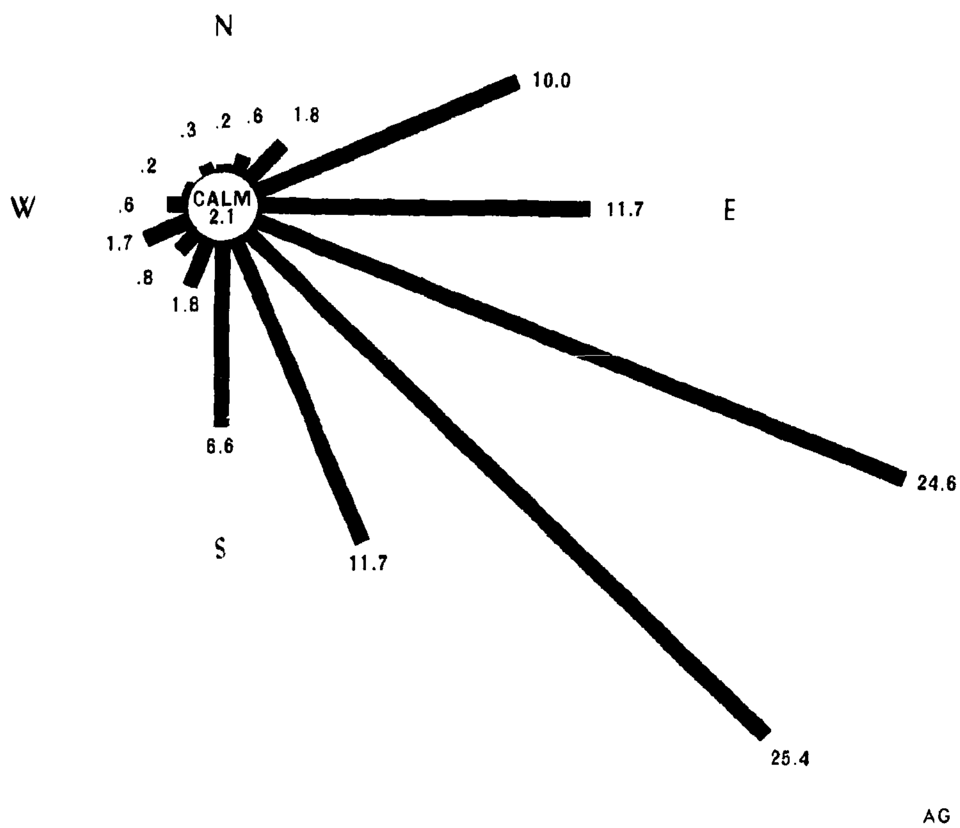

Figure 3.4-3 - Surface wind direction by percent, Camp Fistclench, 19 July to 27 August 1959

They may be taken to represent the environment within the 7-mile radius of operations, inasmuch as the examination of comparable records from the 3 surrounding controller stations reveals no significant departure in regime or magnitude.

3.4.1 Temperatures

The mean temperature for all experimental periods was 14 degrees F; the mean maximum, 21 degrees; and the mean minimum, 3 degrees (Figure 3.4.1-1). The highest temperature was 34 degrees and the lowest was minus 18 degrees. Both extremes were lower than the 5-year[1] records

[1]Surface Weather Records (WBAN 10A & B) Station 17607 (Thule Site 2) Greenland, 1953-1956.

for the month concerned[1]. The temperature was slightly colder than the 5-year mean. A record low temperature for August of minus 18 degrees occurred about 0200 hours on the 23d. Only once did mild thawing occur. This was on 30 July between 1300 and 1700 hours, with a variable easterly wind averaging about 5 miles per hour and high broken overcast. The maximum temperature during this thaw was only 2 degrees above freezing.

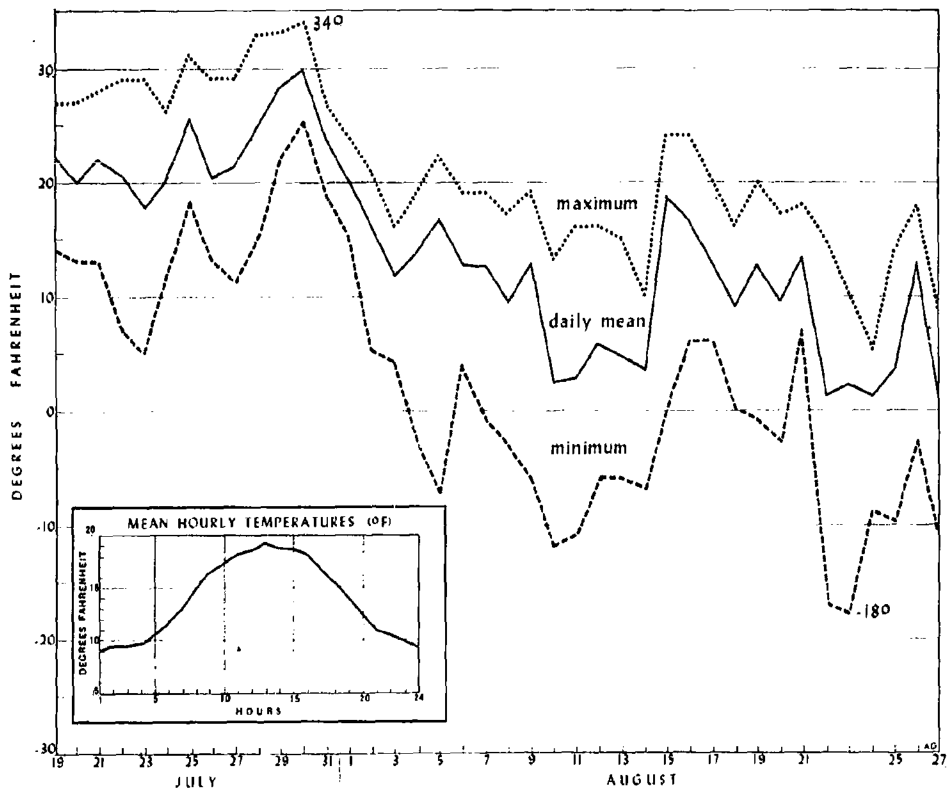

Figure 3.4.1-1 - Extreme and mean daily temperatures (°F)
Camp Fistclench

3.4.2 Windchill and Wind

Windspeeds averaged somewhat less than previous years. The mean velocity was 10 miles per hour (Figure 3.4-2, page 89) and remained at or below that speed for 72 percent of the period. At 10 miles per hour or less, blowing snow did not create any visibility problem. Strongest wind came

[1]U.S.A.E.P.G. Met. Team Data (WBAN 10) Camp Fistclench, Greenland, 1958.

from the northeast, but these were very infrequent. The prevailing surface wind flow was gravity-directed from the higher Ice Cap in the southeast (Figure 3.4-3, page 90). Northwesterly winds occurred only once, for a total of 1.5 percent of the period. Windchill averaged 1,145 KgCals per square meter per hour, which is the same as available years of record. Maximum windchill was 1,775 and the minimum was 300. Windchill values remained at or below the 1400 danger point 85 percent of the period (see Figure 3.4-1, page 89).

3.4.3 General Climate

During the total experimental period, general observations and subjective reactions suggest that altitude, "whiteout," monotony of terrain, and persistent winds were the environmental factors which affected Module performance more than the temperature extremes for this period. Cancellation of 2 experimental days in the sixth period resulted primarily from visibility limitations and high sustaining windspeeds (17 mph).

Effects of continuous sunshine were evident not only as a unique item of conversation, but it tended to alter cultural habits of activity. Its value for direction orientation and navigation was prominent; however, its effects on the Modules were most significant in establishing the value of items such as sunglasses and sunburn cream.

3.4.3.1 Terrain and Surface Conditions

The snow surface varied somewhat in degree of compaction, but very little in general over-all appearance. It was characterized by soft, dry, rippled snow (Figure 3.4.3.1-1) in which boots penetrated ankle-deep. Scattered over this surface at intervals of 50 to 100 feet were short ridges of hard, wind-packed drift, rarely higher than 18 inches, which supported the weight of men without snowshoes.

Following a wind shift from one steady direction to another, these drifts were transformed into snow barchans with wings up to 15 feet long. Such formations might persist for as long as 2 days until the wind shifted back and destroyed 1 wing. Frequently the windward faces of these drifts became scalloped into nests of sastrugi. These would be present for several days through formative and degenerative stages of anvils and cusps before being obliterated. At no time did these drift formations become so large or numerous as to appreciably impede ski or snowshoe trafficability.

3.4.3.2 Visibility

The weather was relatively sunny, 59 percent sunshine or 35.6 minutes per hour on the average.

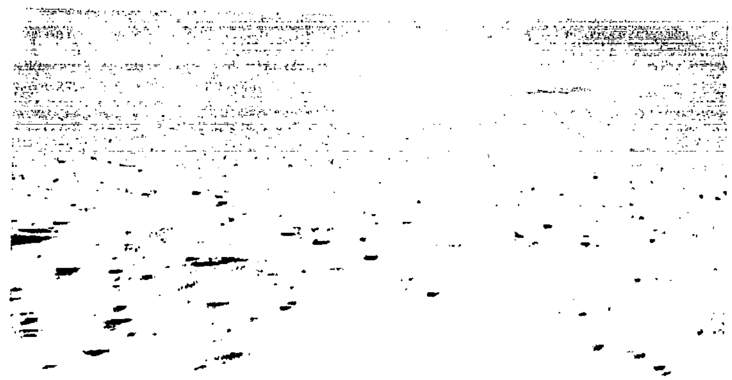

Figure 3.4.3.1-1 - Snow surface near Camp Fistclench, July 1959

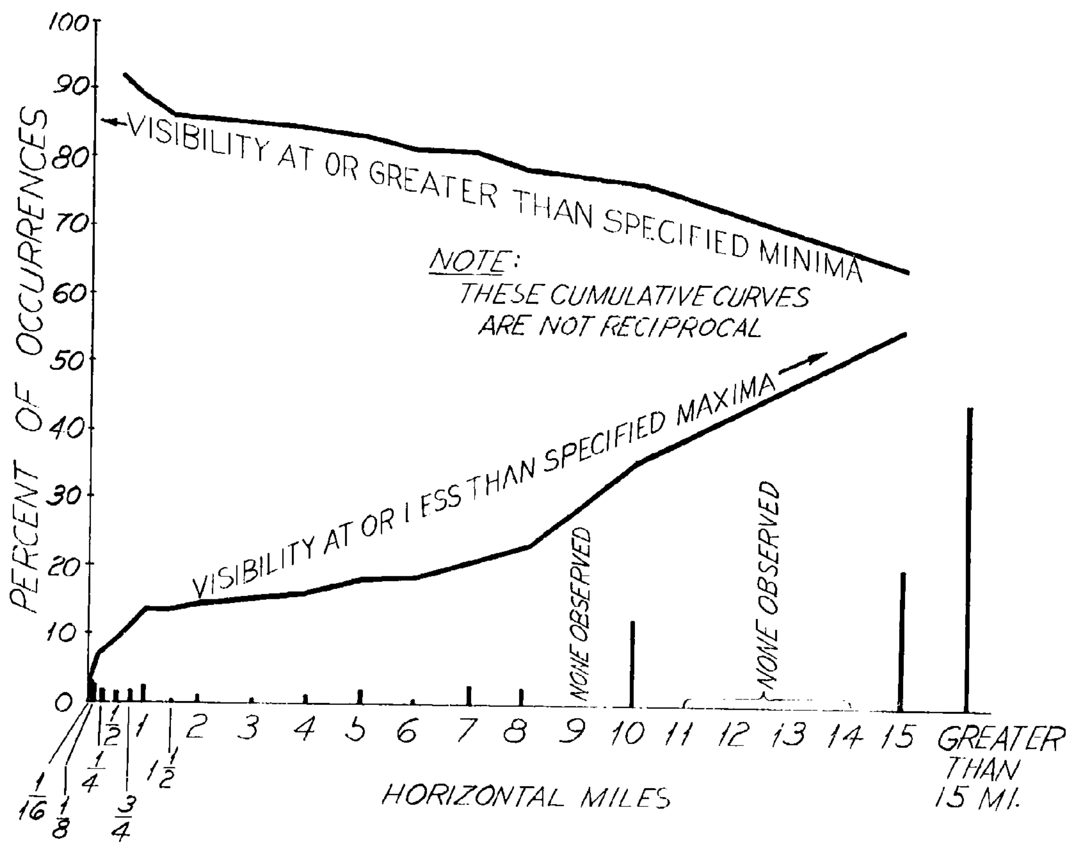

Figure 3.4.3.2-1 - Visibility frequency, Camp Fistclench, 19 July to 27 August 1959

Frequently, during midday when the sun was bright above the southern horizon, a superposed mirage appeared in that direction which resembled a huge scarp of snow. Various observers likened its appearance in size to a 300-foot crater wall at a distance of about 1 mile. In this mirage were reflected the surface irregularities (windrows and sastrugi nests) of the snow surface beyond the visible horizon.

Mean visibility exceeded 14 miles and cloud cover averaged less than 6 percent. Light to moderately dense fog of relatively brief duration occurred 15 percent of the time, and light snow or freezing drizzle accounted for 18 percent. Zero visibility occurred less than 1 percent of the period (Figure 3.4.3.2-1). The coming of fog or snow was always forecast by the appearance of a dark streak along the southern horizon between 30 and 90 minutes before it arrived. Although some precipitation fell on all but 15 of the 40 days, the total measured accumulation was only 5.8 inches of snow.

3.5 SYSTEM EFFECTIVENESS EVALUATION

In paragraphs 3.2, 3.3, and 3.4, the emphasis has been on each of the system elements and the reactive effects from the environment-space-time factors when employed in an independent network of tasks and activities.

The tasks and activities as discussed in paragraph 2.5, and listed in the daily sequence schedule in Table 3.5-1, involved measurements of 3 over-all functional values of system effectiveness. These are: operational, habitational, and restorational. The values for the habitational and restorational indices of each of the POMMS are complex in nature, since they result from integration of discontinuous and sometimes overlapping performance of activity. However, criteria for future experiments are suggested by the results and evaluation of human factors in paragraphs 3.2.4 and 3.3.

Table 3.5-1 - Typical Daily Activity Sequence Schedule of Modules

Time		Activity
0600	-	Reveille
0600-0800	-	Breakfast
0800-0830	-	Strike camp (Day 1, Day 2, Day 5)
0830-1200	-	On trail
1200-1230	-	Trail lunch
1230-1630	-	On trail
1630-1700	-	Pitch camp (Day 1, Day 2, Day 5)
1700-1900	-	Supper
1900-2200	-	Reserved for Questionnaires, etc.
2200	-	Retire

Although inconclusive values of various components of the system were obtained from subjective measurements, it was considered more important at this phase to emphasize an over-all quantitative range of value for each of the systems under study, and to obtain comparative objective measurements which would be indicative of the value of the method for future experimental and analytical work.

To accomplish so complex a study, some details, which can be taken into account in future work, were omitted in order to arrive at comparative magnitudes rather than precise values. Although there may not be a precise consideration of all factors, it is important to emphasize that the utility of these indicators is highly useful, since no criteria of precision for measuring the human factor, as an individual or as a group, have yet been uncovered[1].

3.5.1 Habitational and Restorational Effectiveness

While measurements to obtain objective values of the habitational and restorational performance of the system were difficult, indicators of these values are reflected in the subjective instruments and in the data on weight changes. These are discussed in the following paragraphs.

3.5.1.1 Subjective Effects of the POMMS as the Independent Variable.

Attention has been given, in the analysis of subjective measurements, to the possible effects on the morale and performances of the Modules. General Information Questionnaire Item 3 was planned to be one of these indicators; it requested members' ratings of their Module's performance. Evidence from this item was almost entirely negative; the men rated the performance of their Modules about the same regardless of POMMS. The only effect noted was a consistent increase in ratings of the Modules participating in the second cycle, but this increase applied equally to all 3 POMMS. However, the relative insensitivity of ratings of positive attributes of the Modules has been noted earlier.

Items 1, 2, and 4 of the General Information Questionnaire asked members to describe good and bad features of each POMMS and their use. Main gripes were food dislikes, trail lunch inadequacies, tenting difficulties; these are discussed in paragraph 3.2. Considerable negative attention was given to the uselessness of the entrenching tool. Aspects of the operation most often named as "unpleasant" were: sled pulling and the arguments it caused; getting up in the morning out of damp or frosted sleeping bags; and standing guard duty. The importance of interpersonal relationships is reflected in the datum that "good fellowship" was the aspect most frequently reported as pleasant.

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[1] Quartermaster Food & Container Institute for the Armed Forces, USArmy Symposium, Performance Capacity, Feb 1961

More favorable comments were made about POMMS 59-B-1 than about the other 2. The large shelter and larger stove included with this system were liked, but it was also criticized because of hauling the extra weight this POMMS entailed. There were also some arguments reported about sleeping positions in the POMMS 59-B-1 shelter (4- to 6-man hexagonal tent). The shelter provided under the POMMS 59-C-1 (2-man tents) was disliked particularly, but the lighter load and simpler individual meal type ration were favored. Item 14 of the questionnaire asked the subjects to name what they felt to be the most efficient and the most inefficient of the 3 POMMS. Of 17 nominations of the most efficient in the first cycle, 12 were for POMMS 59-B-1 providing a 5-man tent; 3 were for the POMMS 59-C-1 providing the 2-man tent; and 2 were for the POMMS 59-A-1 requiring the use of in situ shelter. Of 17 nominations for the most inefficient systems, 8 were for POMMS 59-C-1; 8 for POMMS 59-A-1; and only 1 mention was made of POMMS 59-B-1. Reasons for these choices generally were given in terms of shelter provided and load-pulling required; food seemingly was not a criterion of choice.

3.5.1.2 Bulk Physiological Effect of the POMMS

Table 3.5-2 illustrates the weight changes on a Module basis. The values shown for the net Module impact are highly variable and may in part be accounted for by the lack of close control of food intake between experimental periods as suggested in paragraph 3.2.4. A more substantial reason for this may lie in the lack of control on water intake measurement and measurement of weight losses of Module elements who were periodically replaced. Unfortunately, weight data for the sixth experimental period are also absent and the complete trend of each Module's net weight change is not obvious. What appears consistent is the continued increasing weight losses of all Modules with time. Although net Module impact data would appear to be variable and might be regarded as inconsistent, these data do indicate the effect of each POMMS as an independent variable and provide a rank order of their relative restorational index.

The weight changes may be assumed to be an index of the tendency of each of the POMMS to restore or remove energy storage levels of the Modules. POMMS 59-C-1 shows that it extracted the highest toll of energy storage from all of the Modules for the total period. As compared with the loss from POMMS 59-C-1, the effect of the other 2 systems is insignificant. The proximity of values between POMMS 59-B-1 and 59-A-1 seems to indicate that a favorable influence or desirable design feature might be found in the general similarities of these 2 systems. The 2 features can be detected in the influence of group habitability and the design of food ration and related service technique.

Table 3.5-2 - Impact of POMMS on Module Weight

Module	POMMS																		Net Module Impact
	59-A-1 Period						59-B-1 Period						59-C-1 Period						
	1	2	3	4	5*	6	1	2	3	4*	5	6	1	2	3	4	5	6*	
Alpha	-1.5								-4.75					-2.0					-8.25
Bravo		+2.75					+8.25								-4.5				+6.5
Charlie			-4.75					+0.5					+2.5						-1.75
Delta						#					-10.75					-12.0			-22.75
Echo				-1.0								#					-6.25		-7.25
Net POMMS Effect	-4.5						-6.75						-22.25						
Restorational Index Rank	1						2						3						

NOTE: - denotes weight loss (lb)
+ denotes weight gain (lb)
# denotes weight measurements not obtained
* POMMS non-operational during these experimental periods

3.5.2 System Operational Effectiveness

The experiment was designed to obtain usable data stripped of the usual comparison of single components. The experimental design and procedure assisted therefore in providing a prototype method by which conventional theoretical optimums of system performance based on a single faulty component, inadequate training, or inadequate equipment, could be avoided in favor of obtaining measurements of integrated compatibility.

Keeping in mind 2 major areas of concern in any military system, the experiment was directed to see whether: first, the operational advantage of one system over another could be detected by this method through quantitative data, and second, what logistical relationship might be found in terms of over-all quantitative performance values determined from purely operational tasks measuring mobility and transportability.

In dealing with the POMMS which are designed as elementary military systems, i.e., nonmechanized units, the complex interaction of human factors, either in the role of a system element or as its controller, cannot be avoided. However, reduction of variability influence because of individual roles was reduced through handling of data on a group or Module basis. The influence of variability from the Modules was reduced by the procedure of rotation and reorganization to form new Modules for the second cycle. "Failure" of one of the Module elements prevented the use of 3 complete Modules after the first experimental period. However, the experiment as designed permitted continuation on the basis of 2 complete Modules for each period.

The modified role of Module "Charlie" after the first experimental period is detectable in the operational task factors measured. It is also reflected in the data previously discussed in paragraph 3.2.4 under food consumption. Although the Module was modified by loss of one element, its over-all energy consumption appeared to remain the same. On the basis of individual consumption, the level of energy input rose by about 400 calories per day.

The results which follow were derived primarily from the operational tasks "Microlog" and "Microtac." The Microlog involved movement of the entire materiel system, and the Microtac standardized the load carried by each Module element at approximately 40 pounds.

Table 3.5-3 shows the record of data obtained on the weight of components and over-all Microlog loads, exclusive of the clothing system worn, for each POMMS. The load of the lightest system (POMMS 59-A-1) is 104 pounds lighter than that of POMMS 59-C-1 and 175 pounds lighter than the heaviest POMMS 59-B-1. The Microtac load is typified by the weight measurements in Table 3.5-4. The variation between the lightest

and heaviest load for the Modules was less than 20 pounds or about 3.2 pounds per Module element. Of the total of 54 Microtac tasks measurements planned for the total experimental period, 18 measurements were obtained. While this restricted opportunity to confirm the influence of each of the Module characteristics on the systems, the data do indicate that variability between Modules was not significant.

Table 3.5-3 - Typical "Microlog" Load

			POMMS					
		Unit Wt. (lb)	59-A-1		59-B-1		59-C-1	
			Qty.	Wt.	Qty.	Wt.	Qty.	Wt.
1.	Can, gas, 5 gal	9.88	1	9.88	2	19.76	1	9.88
2.	Candles			1.00		3.00		1.00
3.	Container, fuel, 1 qt	0.44	2	0.88	2	0.88	3	1.32
4.	Container, water, 6-in-1	12.71 (full)	1	12.71	0	-	0	-
5.	Cookset, mountain	1.50	2	3.00	2	3.00	3	4.50
6.	First aid kit	2.00	1	2.00	1	2.00	1	2.00
7.	Flashlight	0.40	1	0.40	1	0.40	1	0.40
8.	Gasoline	6/gal	2.5 gal	15.00	10 gal	60.00	5 gal	30.00
9.	Harness, single trace	0.88	6	5.28	6	5.28	6	5.28
10.	Helmet w/liner	3.00	6	18.00	6	18.00	6	18.00
11.	Machete w/sheath	1.98	2	3.96	2	3.96	2	3.96
12.	Pistol, flare, w/flares	4.18	1	4.18	1	4.18	1	4.18
13.	Pressure cooker	3.00	-	-	1	3.00	-	-
14.	Ration							
	Meal, combat, individual		-	-	-	-		143.76
	Meal, small detach, 5-in-1		-	-		145.00		-
	Quick-serve meal			99.00		-		-
15.	Rifle M-1	9.50	1	9.50	1	9.50	1	9.50
16.	Rope, climbing		1	15.00	1	15.00	1	15.00
17.	Rucksack ("Microtac") load as in Table 3.5-4	40.90 to 44.10	6	245.46	6	264.72	6	262.74
18.	Sled, scow-type, 200 lb capacity	32.43	2	64.86	2	64.86	2	64.86
19.	Spout, can, flexible	1.94	1	1.94	1	1.94	1	1.94
20.	Stove, Yukon	21.78	0	-	1	21.78	0	-
21.	Tent, hexagonal, M1951, compl.	40.92	0	-	1	40.92	0	-
22.	Tent, mountain, 2-man	12.56	0	-	0	-	3	37.68
	TOTAL WEIGHT PER MODULE			512.05		687.18		616.00
	TOTAL LOAD PER MODULE ELEMENT			85.34		114.53		102.66

Table 3.5-4 - "Microtac" Load per Module Element

		POMMS		
		A	B	C
1.	Can, gas, 1 qt*	-	2.00	-
2.	Canteen (full)	4.00	4.00	4.00
3.	First aid kit*	2.00	2.00	2.00
4.	Gloves, anti-contact	0.03	0.03	0.03
5.	Intrenching tool	2.50	2.50	2.50
6.	Mattress, pneumatic	2.31	2.31	2.31
7.	Mess utensils	-	0.39	0.39
8.	Overwhites (parka & trousers)	2.86	2.86	2.86
9.	Parka w/liner	5.92	5.92	5.92
10.	Poncho	-	2.82	2.82
11.	Rucksack	4.99	4.99	4.99
12.	Sleeping bag, arctic, w/water repellent cover	14.90	14.90	14.90
13.	Stove, one-burner*	1.98	1.98	1.98
14.	Thong, emergency	0.07	0.07	0.07
15.	Toilet articles	2.00	2.00	2.00
16.	Trail meal*	4.00	2.00	2.00
	Total load per Module element (lb)	40.91	44.12	43.79
	Total load per module (lb)	245.46	264.72	262.74

* Items distributed evenly among Module elements.

3.5.2.1 Output Factors

The basic objective measurements of output which reflect over-all useful performance information were considered to be a result of the operational activities of each total system. The factors on which analyses were focused were: (1) movement rate or mobility, (2) unit rate of effort or transportability, and (3) total level of operational effort.

3.5.2.1.1 Mobility - Rate of Movement

The rate of movement was derived from data based on the total distance moved by each Module during its operational time period. Considering the POMMS as the independent variable, it is reasonable to predict that the Module moving with the lightest POMMS would attain the highest mobility. During movements with the standardized load of the Microtac activity, it could be expected that all Modules would move at about the same rate and would improve in all rates of movement with time as Modules became acclimatized and gained experience.

Figure 3.5-1 shows the increasing trend of Microlog traces in the mobility factor for all the POMMS and the scatter of points for the Microtac data. Variability in the data reflects to some extent the interacting effect of each Module and results of different capabilities and motivation. Alteration in the prescribed movement distance accounts for the scattering of data for the Microtac task in the fifth experimental period. The low point for all POMMS occurs in the first period. High points, however, for each of the POMMS occur in different periods, with peaks for POMMS 59-A-1 and 59-C-1 in the sixth period, and POMMS 59-B-1 in the fifth period. The advance of consistently lower temperatures and improved snow surface trafficability cannot be overlooked as an important interaction resulting in the high rates of movement, particularly in the fifth and sixth periods.

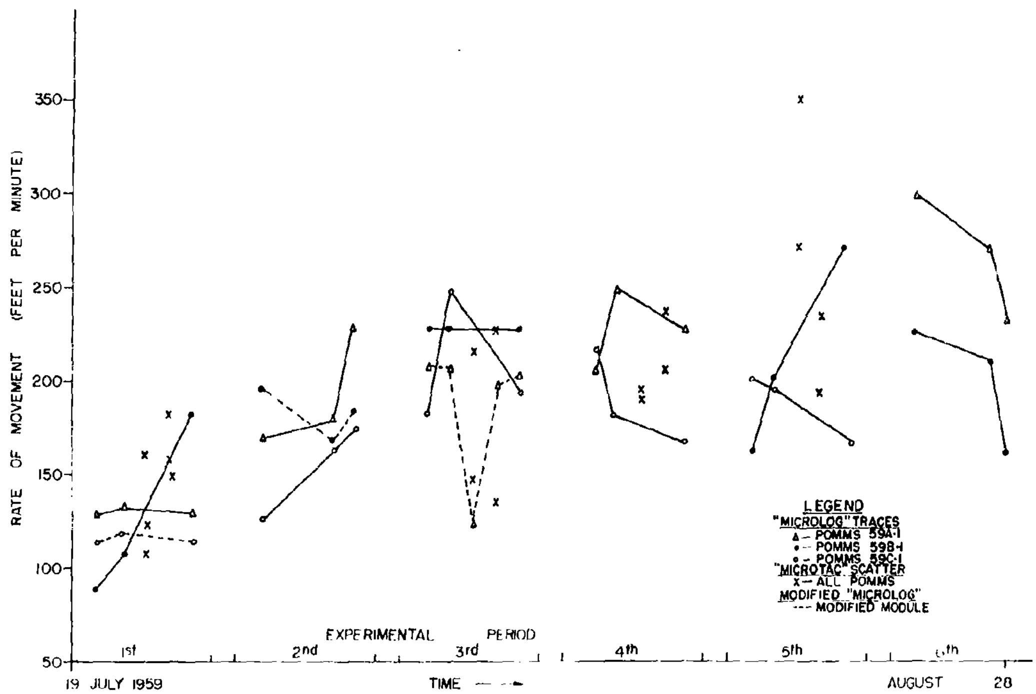

Figure 3.5-1 - Output Factor - Rates of Movement (systems trace and scatter)

Table 3.5-5 - Average Rates of Movement (feet per minute) "Microlog"/"Microtac" Activities for each System

	POMMS																		
	59-A-1						59-B-1						59-C-1						
	Period						Period						Period						Average Module Rates
Module	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	
Alpha	130/137								228/222					155/-					171/180
Bravo		193/-					126/115								209/142				176/129
Charlie			203/-					183/-					114/88						167/88
Delta						270/-					212/298					190/202			224/250
Echo				228/216								202/-					224/234		218/225
Gross Average Rates for Micro-log/Microtac	205/177						190/212						178/167						

Although the Modules employing the POMMS 59-C-1 had a load lighter than the Modules using the POMMS 59-B-1, the over-all trend shows greater mobility with the heavier system. This may be accounted for by the negative influence of the POMMS 59-C-1 on Module attitude as discussed in paragraph 3.5.1.

The differences in over-all mobility of each POMMS are clearly evident in Table 3.5-5, where the average rates of movement are shown for the Microlog tasks, in feet per minute: 205 for POMMS 59-A-1, 190 for POMMS 59-B-1, and 178 for POMMS 59-C-1. Also shown in Table 3.5-5 are the average rates of movement involving the Microtac tasks.

The high average value shown for the POMMS 59-B-1 Microtac rate of movement appears significant. Examination of the daily data for this period suggests two possibilities: One of the values (298) is sufficiently unique and is inconsistent with other daily data for the fifth period; or if we discount this particular value for the period, the calculated average rate for POMMS 59-B-1 Microtac activity would result in value of 168 feet per minute. This then would be consistent with other Microtac values for other POMMS. The small number of data samples for the Microtac load, however, limit any inferences which may be obtained in this way except to demonstrate possible advantages of a pulled load over a back-carried load.

If we examine the data based on the Module as the independent variable, we find that the Modules in the second cycle tended towards better mobility in the Microtac activity than in the Microlog. Here again the data are incomplete; however, the first cycle shows a general better mobility with the Microlog activity than with the Microtac. Over-all, the Module capabilities in each cycle are comparable, and particularly so with both Modules in the second cycle.

Compared with available military data for northern areas[1], the Module capability can be regarded as significant. Some rates of movement attained show that personnel moving large loads as a group can achieve, in this environmental space-time frame of reference (on the Greenland Ice Cap in summer), movement rates as high as 3.4 mph on snowshoes.

3.5.2.1.2 <u>Transportability - Unit Rate of Effort</u>

The transportability factor is derived from the product of the mobility factor and the load moved. Actually, the transportability factor is the rate at which work was done or effort required to be expended by Modules based upon interactions with the weight factor of each POMMS.

[1] US Dept of Army FM 31-71, Basic Cold Weather Manual, February 1951, Chapter 4.

Also considered in this factor was the influence of each system load on the "dwell" or "downtime" of each Module. The ratio of mobile to immobile or rest time was included to adjust the rates of effort, in order to reflect longer rest periods required by a Module with a heavy POMMS requiring longer or more frequent break periods but moving at a high rate of speed between breaks.

In Figure 3.5-2 the adjusted rates of effort are plotted to show the trace pattern for each period. The general trend of the traces shows an increasing rate of effort from the first to the sixth period, and a predictably higher output for the Modules employing the heavier POMMS. The sixth period begins to indicate, as can be seen from Figure 3.5-1 (page 101) the increased transportability influence of the higher rate of movement attained with the POMMS 59-A-1.

The Microtac scatter in Figure 3.5-2 appears reduced. This clearly shows the gradually increasing output of the Modules with time and comparable performance for almost identical loads. The modified Module, consisting of 5 elements in lieu of 6 and performing a modified Micro<u>log</u> activity, is plotted to illustrate that its lightest load, which was almost 15 pounds heavier on the basis of a Module element, tends to show a rate of effort comparable to the 6-man Modules engaged in the Microtac activities. Although inconclusive, the data do indicate an advantage of a pulled load over a carried load moving over the snow.

3.5.2.1.3 <u>Levels of Operational Effort</u>

Figure 3.5-3 shows the trace of system characteristics independent of the Module role. Here the variability is due primarily to systems load variations and alteration of prescribed distances. The figure traces the range of each system's output, at least that output considered to be useful. These data are derived from the operational loads pulled or carried, and the distances over which they were moved. As work energy units, the data were converted to equivalent heat in British thermal units (Btu).

As would be expected, the heavier POMMS show a higher level for the same distance. However, it is significant to note that where sharp variations occur upward, these are due primarily to increased distances which may tend to infer growing Module confidence. Sharp declines in the traces indicate reduction in load and reduction in distance. Further examination of the data shows the effect also of some overlapping influences from unusual habitability energy expenditures. For example, a low point was reached by the Module employing POMMS 59-A-1 in the fourth period because energy of the Module was expended in overcoming damage to its shelter.

The Microtac scatter here appears more sharply reduced and confirms the fact that the load and distance were controlled. The scatter in Figures 3.5-1 and 3.5-2 can thus be regarded as characteristic of the variability in Module performance due to capability, motivation and leadership.

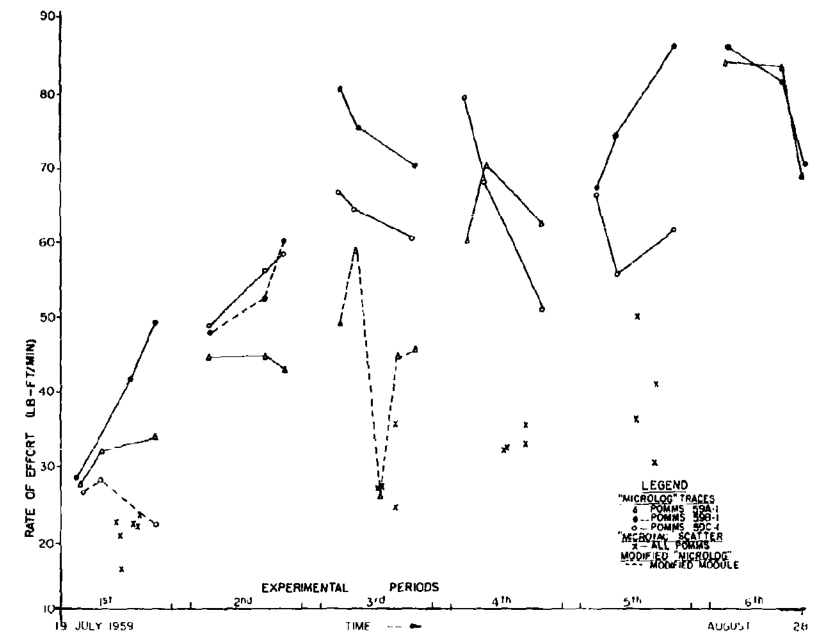

Figure 3.5-2 - Output Factor - adjusted rates of effort (systems trace and scatter)

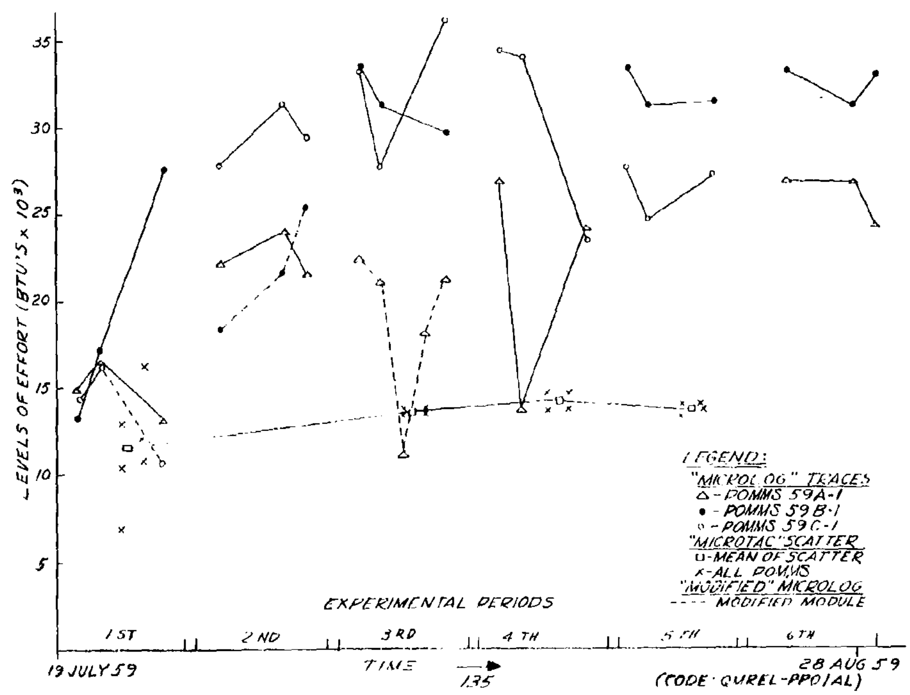

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Figure 3.5-3 - Output Factor - level of operational effort (systems trace and scatter)

3.5.2.2 Input Factors

The basic input to any man-machine system performance is energy, and in the Module-POMMS systems the energy was in the forms of food and fuel. These 2 input factors were primary quantities which influenced the apparent effectiveness of each system as shown in paragraph 3.5.4.

Figures 3.5-4, 3.5-5, and 3.5-6 chart the food-fuel inputs on a Module basis for each POMMS for each day of the experiment. Day 6 has been discarded because it was not a complete experimental day and represented a phasing out of each experimental period.

Fuel measurements were made in quarts and converted to Btu's[1] based on available API gravity data on arctic military gasoline[2]. Accuracy of fuel measurements cannot be considered better than plus or minus 15,000 Btu's.

Food measurements were made as described in paragraph 3.2.4. To integrate total input to each system on a consumer measure, the calories per individual were converted to Btu's on a Module basis.

The food input to each system remained below the prescribed experimental limitation of 4800 calories per individual element or 114,336 Btu's per Module. The food input trends of all 3 systems show only a limited response to the influence of decreasing temperature trend (see Figure 3.4-1, page 89) and increasing rate of effort of the Modules as traced in Figure 3.5-2. It would appear that the increasing trend in each system is more indicative of a training and familiarization curve. It is, however, clear that the food input levels differ in the same relative way that each of the systems differ by total weight characteristics.

A sharper discrimination between the energy inputs characteristic of each system is found from the fuel input values for each POMMS. The energy cost in fuel for the POMMS 59-B-1 is immediately evident. The low fuel requirement for the POMMS 59-C-1 is evidence of economy which may be obtained by smaller group shelter design. At the same time, the high fuel input required for the POMMS 59-B-1 is also evidence of the tendency of the Modules to require higher fuel input when operational output factors were low. Of particular interest and significance are the second and third experimental days of the sixth period for POMMS 59-B-1. On these 2 days the operational output factor was reduced to zero because of navigational restriction resulting from a "whiteout." Yet with a zero operational output, fuel input requirements rose. This situation is also

[1]Thermal Properties of Petroleum Products, NBS(U.S.) Misc. Pub. 97 (1933)
[2]Laboratory Analysis Report. G. E. Calef. QMREC Petroleum Laboratory, 1959

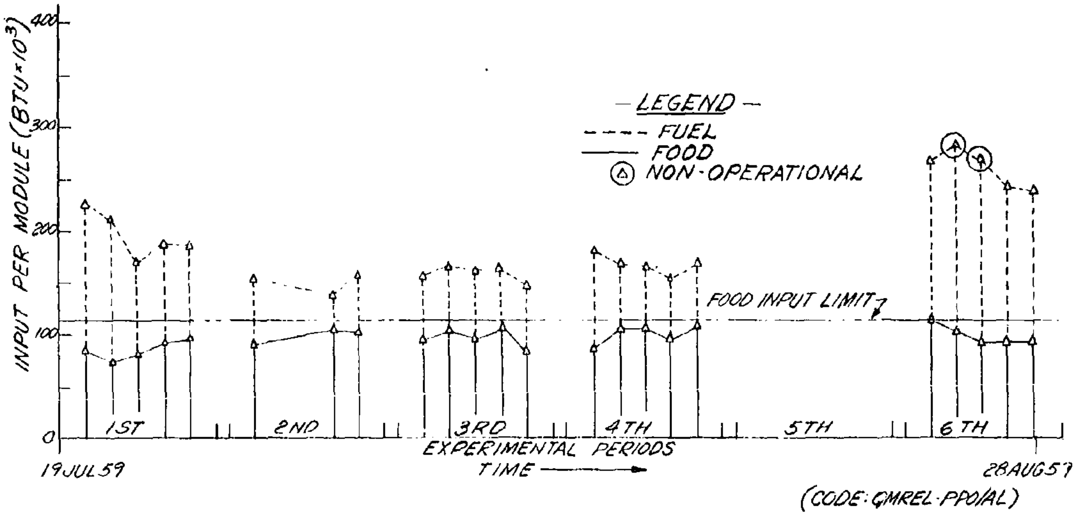

Figure 3.5-4 - Input Factors: fuel-food input to POMMS 59-A-1 per Module basis

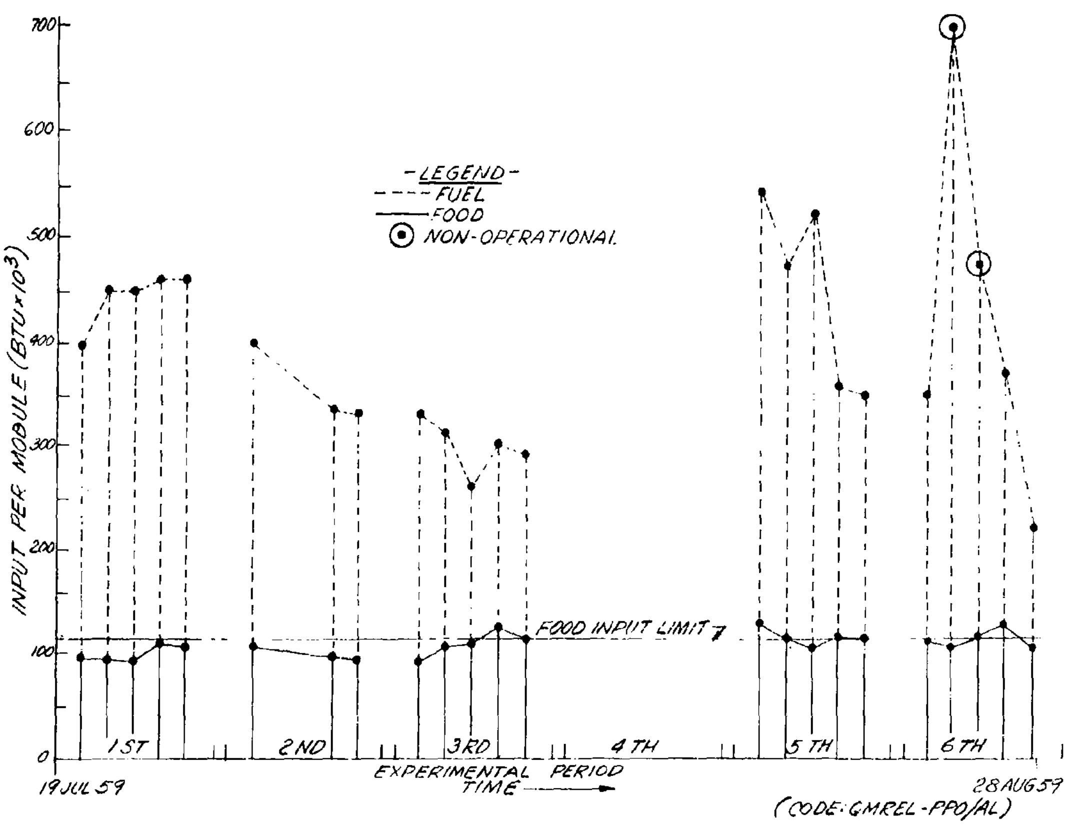

Figure 3.5-5 - Input Factors: fuel-food input to POMMS 59-B-1 per Module basis

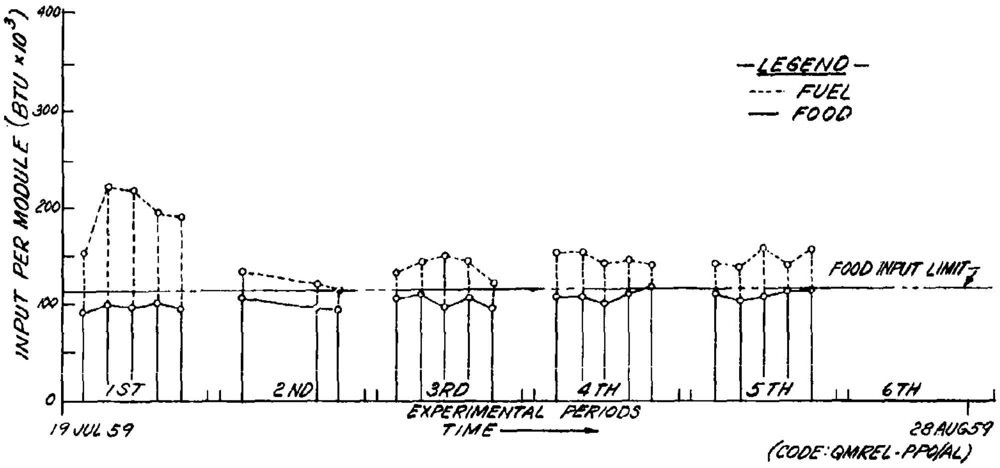

Figure 3.5-6 - Input Factors: fuel-food input to POMMS 59-C-1 per Module basis

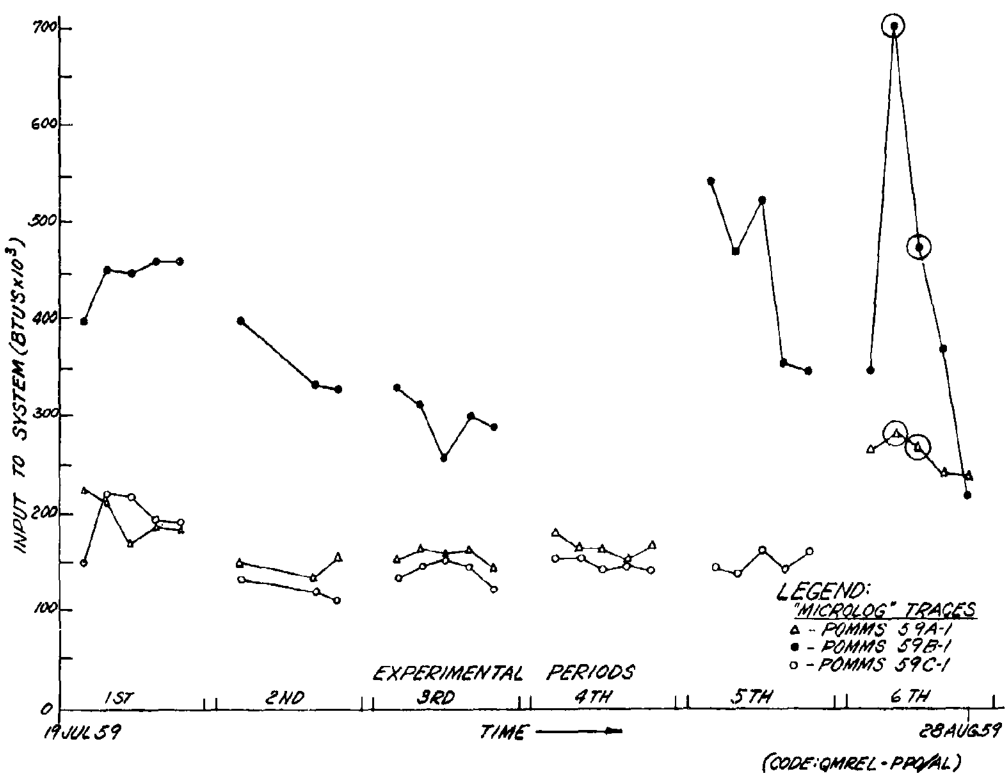

Figure 3.5-7 - Input Factors - total input to systems (systems trace)

true of POMMS 59-A-1 but to a lesser magnitude because of the inherent design limits incorporated in the system. It is therefore not unreasonable to conclude that fuel requirements for small dismounted units tend to vary inversely with their level of operational effort.

Figure 3.5-7 charts the total input traces of each system. POMMS 59-B-1 reached its maximum and minimum inputs during the experimental period of the severest weather. Mean windchills ranged from a high of 1705 on the first day to 1668 on the second, 1290 on the third, and 1579 on the fourth. Total input is not consistent with this variability; however, the high reached was 706 x 10^3 Btu per Module per day and the low in this same period was 223 x 10^3 Btu per Module per day. This high degree of variability is consistent with the flexible fuel consumption capability incorporated in the POMMS 59-B-1.

With the POMMS 59-A-1, the operation of the system appears to be more responsive to the climatic trend. Period 1 indicates more the influence of a Module training factor than consistency of consumption with the temperature and windchill trend. The lowest windchill and highest temperature occurred in the second period. The lowest input corresponds with the day this condition was reached. The low reached was 133 x 10^3 Btu per Module per day. The high input was reached on the same day, coincident with POMMS 59-B-1, but at about 40 percent of its value. The highest input occurred on the second day of the sixth period and was calculated to be 282 x 10^3 Btu per Module per day.

The trend of POMMS 59-C-1 closely follows the traces of POMMS 59-A-1. Since the POMMS 59-C-1 was not operational in the sixth period, full comparisons are not possible. The trend of input traces, except for the first period, show inputs less than the POMMS 59-A-1. The lowest input of 113 x 10^3 Btu is reached during the same period as for the POMMS 59-A-1. The highest input is reached in the first period, at temperatures less severe than the fifth period. An input of 220 x 10^3 Btu per Module per day was obtained; if we discount the first period influence due to training, a high of 163 x 10^3 Btu per Module per day may be considered as maximal. This input appears to be also related to the high windchill factor of 1405 reached on the same day.

3.5.3 Adjusted Index of System Effectiveness

The adjusted index of system effectiveness for each POMMS was obtained as described in paragraph 1.4.3

At this phase, the index obtained is considered to be representative of the quantitative value for each POMMS. Table 3.5-6 shows the computed average values for each system during each experimental period without consideration of the time adjustment factor. Table 3.5-7 shows values after being adjusted by the correction factor due to time.

Table 3.5-6 - Index of System Effectiveness (ISE) (Microlog Task)

	POMMS																		
	59-A-1						59-B-1						59-C-1						
	Period						Period						Period						Module Index
Module	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	Average
Alpha	7.1								10.1					24.1					13.8
Bravo		14.1					4.3								24.5				14.3
Charlie			13.2					6.2					7.5						8.9
Delta						10.5					7.2					20.2			12.6
Echo				15.0								11.0					18.4		14.8
Average POMMS ISE	12.0						7.8						18.9						

Table 3.5-7 - Adjusted Index of System Effectiveness (AISE) (Microlog Task)

	POMMS																		
	59-A-1						59-B-1						59-C-1						
	Period						Period						Period						Module Index
Module	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	Average
Alpha	4.7								5.7					15.8					8.7
Bravo		8.8					2.4								15.1				8.8
Charlie			8.9					4.6					4.4						6.0
Delta						6.4					4.4					13.2			8.0
Echo				8.9								7.6					12.1		9.5
Average POMMS AISE	7.5						4.9						12.1						

The over-all average of the indices obtained from each experimental period detects the relative quantitative levels of each of the POMMS. POMMS 59-C-1 shows that of every100 energy units fed into it, at least 12.1 percent are operationally effective; for POMMS 59-A-1, 7.5 percent, and for POMMS 59-B-1 only 4.9 percent.

By considering the Modules as independent variables, the average index for each Module is determined. The Module indices show that Alpha, Bravo, and Delta are closely comparable. Module Echo appears to have a slight advantage of 1½ percent over Module Delta. This would tend to show that this group could have improved the performance of any of the POMMS with which it interacted. On the other hand, the disadvantage of Module Charlie is also evident, since it was modified to 5 Module elements after the first 3 days of the first experimental period. It is reasonable to conclude, therefore, that the variability between Module performance is insignificant, and the differences between the POMMS are significantly represented by the AISE's shown in Table 3.5-5, page 102.

3.5.4 Combined Evaluation

There are 2 major sources of measurements from which an evaluation of the POMMS may be obtained. One is from the subjective measurement "instruments" and the other is from the measurements used to derive the AISE. The over-all subjective ratings of the POMMS are discussed in paragraph 3.5.1.1. The comparison of ratings by rank order is given below.

	Subjective Efficiency Rank	Objective Efficiency Rank
POMMS 59-A-1	3	2
POMMS 59-B-1	1	3
POMMS 59-C-1	2	1

The discrepancy between the ratings is to be expected, since the subjective efficiencies were expressed in terms of personal comfort. At the same time, the extra weight of POMMS 59-B-1 was criticized and the lighter load and simpler food system of the 59-C-1 were favored. This obviates a discrepancy between the 2 ratings. However, sufficient evidence is contained in this report to guide the future development of obtaining closer ranking by using the AISE values as the best quantitative criteria for future experiments. While the subjective efficiency rank is indicative of user preference, the objective efficiency rank reveals the probability of order of supplier preference and logistical impact.

4. CONCLUSIONS

Of all the diverse factors which entered into this study, the effect of altitude and limited conditioning of the personnel, both as individuals and as Modules, imposed the major impact in the man-equipment system study concept. The performance of the human factors, for the period observed, shows improvement even with increase in apparent stress due to environment and exposure to lower temperatures.

The effect of the three POMMS upon personnel groups is reflected to the greatest extent in the subjective evaluations of reactions to individual experiences with each of the systems, since these preferences of the POMMS 59-B-1 were found to be based primarily on reaction to the habitational comfort provided the individual.

The methodology and procedures evolved for this experiment establish a basis for developing improved measurements and standards for the evaluation of QMC systems of materiel.

4.1 OUTPUT PERFORMANCE

The operational effectiveness of the 3 systems was found to be influenced by 3 principal factors: restorability, habitability, and mobility. Based on the measured aspects of these factors in the space-time environment of this phase, the POMMS 59-A-1 ranked highest in restorability and mobility; the POMMS 59-B-1 ranked a close second, and the POMMS 59-C-1 ranked a low third. Habitability of the POMMS 59-B-1 ranked highest, based on subjective measurements. This was due to "comfort" provided by the hexagonal tent and heating facility. On this same basis, the POMMS 59-A-1 ranked lowest.

While there were a number of individual criticisms of the POMMS 59-B-1 in terms of its high weight level, Module mobility was highly variable. Module mobility using this POMMS proved to be greater than with the lighter POMMS 59-C-1 but less than with the lightest POMMS 59-A-1.

For all the systems, the "Microtac" task (movement with individual loads) showed general reduction of the rate of movement of all Modules as compared with the "Microlog" tasks (movement by group load). Modules moved larger loads more rapidly by sled hauling than they moved lighter loads by back carry.

Rates of movement in excess of 250 feet per minute (2.9 mph) were consistently obtained with all systems. Maximum of 300 feet per minute (3.4 mph) was obtained with the POMMS 59-A-1. Decreasing temperature coincident with improvement in trafficability was an important factor in increasing mobility.

4.2 INPUT-OUTPUT PERFORMANCE

The indices of system effectiveness, although not conclusive at this phase of the study, establish objectively derived values. Together with subjective measurements, these values may be used in making judgments on the compatibility of system components and the economics of system support.

The over-all index of effectiveness shows which system imposes the minimum impact on supporting systems. Based on the results of this experiment, the POMMS 59-C-1 ranks most effective.

The requirement for energy input, primarily fuel, tends to be significantly influenced as the mobility factor approaches zero. Simply stated, fuel requirements increase as the group tends to remain static.

The fuel factor for POMMS 59-B-1 is 0.43 gallons per man per day and is the most costly to the fuel logistic system. The least costly (POMMS 59-C-1) is in the order of 0.07 gallons per man per day.

4.3 NOTE ON CALORIES

The ration allowance for the Greenland area is 7200 calories, 1.5 times the basic 4800 calories allowed by the Master Menu of the Northeast Air Command. By this criterion, the Module elements in the present study would be considered on a starvation diet. That their measured consumption of 4300 calories per man was adequate shows that the official allowance is far in excess of caloric need. The Module elements were doing heavy physical labor while living under conditions which required greater energy expenditure than for the average camp-based soldier; also, during the week they did not have access to alternate food sources such as the Post Exchange which are available to almost every serviceman. Yet there were only 6 days when average consumption was over 5000 calories, and the maximum recorded was 5425.

APPENDIXES

APPENDIX 2.2-1/A

APPENDIX 2.2-1/A

IDENTIFICATION OF POMMS 59-A-1

SUMMARY LOGISTIC CHARACTERISTICS

Subsystem	Cost ($)		Weight (lb)		Cube (cu ft)	
1. Clothing						
a. Organizational	624.60		203.26		14.28	
b. Personal	102.00		31.93		2.00	
		726.60		235.19		16.28
2. Shelter and Protection		356.76		147.49		10.56
3. Heating (Food and Personnel*)		17.58		35.58		1.65
4. Food, Food Service, and Sanitation**		223.50		122.21		4.36
5. Operational Equipment		356.16		159.78		34.59
TOTALS		$1680.60		700.25		67.44

*Includes basic fuel supply component for 3 days operation.

**Includes basic food supply for 3 days operation.

APPENDIX 2.2-1/A (cont.)

POLAR MATERIEL SYSTEM 59-A-1
(POMMS 59-A-1)

Subsystem	Component	Federal Stock Number	Quantity	Weight	Cube	Cost
1. Clothing						
	a. Organizational					
	Boot, combat, insulated, cold dry, rubber, white, plain toe, rubber chevron sole and heel	(experimental)	6 pr	31.28	3.30	63.00
	Cap, field, cotton, poplin, wool pile, OG, QM shade No. 107	8405-268-8027 thru 8032	6	3.30	0.16	9.60
	Coat, cotton, wind resistant, sateen, water repellent treated, OG, QM shade #107, slide fastener closure (combat)	8405-255-8583 thru 8591	6	19.93	0.90	69.60
	Gloves, anti-contact	8415-298-1934 thru 1936	6 pr	0.53	0.04	4.50
	Helmet, steel	8415-161-9411	6	13.62	0.38	10.50
	Hood, winter, cotton warp, nylon filled, oxford, OG, QM shade #107	8405-266-7750	6	12.00	0.94	30.90
	Liner, coat, natural, mohair, frieze, 16 oz	8405-261-6591 thru 6594	6	13.86	1.13	48.90
	Liner, helmet, steel	8415-240-2514	6	5.28	0.38	28.80
	Liner, parka, mohair, frieze, natural	8405-240-2460 thru 2463	6	15.71	1.10	63.90
	Liner, trousers, arctic, mohair, frieze, natural	8405-261-6845 thru 6853	6	11.88	0.72	45.60
	Mitten, inserts, wool and nylon knit, trigger finger, OD	8415-160-0769 Med 8415-160-1376 Lge	6 pr	1.30	0.12	5.70
	Mitten set, arctic, cotton, oxford, gauntlet, OD, type 1	8415-268-7690 thru 7693	6 pr	13.20	1.90	51.00
	Parka, cotton, jean, 4.8 oz, white	8405-223-7628	6	10.26	0.58	20.70
	Parka, cotton-nylon, oxford, OG, QM shade #107	8405-223-7621 thru 7624	6	19.80	0.90	75.90

APPENDIX 2.2-1/A (cont.)

POMMS 59-A-1

Subsystem	Component	Federal Stock Number	Quantity	Weight	Cube	Cost
1. Clothing (cont.)						
	a. Organizational (cont.)					
	Shirt, wool, 16 oz, OG, QM shade #108	8405-188-3791 thru 3798	6	9.37	0.90	39.90
	Suspenders, trousers, scissor type back, OG, QM shade #107	6440-221-0852	6	2.10	0.11	3.90
	Trousers, cotton, jean, 4.8 oz, white	8405-240-6295	6	6.00	0.25	12.30
	Trousers, cotton-nylon, OG, QM shade #107, M-1951	8405-265-0379 thru 8387	6	13.84	0.47	39.90
	TOTALS - Clothing, Organizational			203.26	14.28	624.60
	b. Personal					
	Drawers, ankle length, 50% cotton, 50% wool, ribbed knit, natural	8420-269-5587 thru 5591	12	11.62	0.65	31.80
	Gloves, insert, wool, knitted, OD	8415-160-0815 thru 0817	12	0.79	0.09	9.00
	Gloves, shell, leather, M-1949	8415-160-0883 thru 0887	6 pr	1.72	0.10	10.20
	Socks, wool, OD, shade #9, cushion sole, 15" length	8440-264-2923	36 pr	7.20	0.50	19.80
	Undershirt, 50% cotton, 50% wool, full length sleeve, natural	8420-197-2884 thru 2887	12	10.60	0.66	31.20
	TOTALS - Personal Clothing			31.93	2.00	102.00
Clothing Subsystem TOTALS				235.19	16.28	726.60

APPENDIX 2.2-1/A (cont.)

POMMS 59-A-1

Subsystem	Component	Federal Stock Number	Quantity	Weight	Cube	Cost
2. Shelter and Protection						
	Bag, sleeping, arctic	8465-238-8107	6	96.00	7.20	237.30
	Brush, mountain	7920-292-4372	6	0.22	0.06	7.50
	Case, water repellent, bag, sleeping	8465-237-8719	6	14.88	0.60	30.54
	First aid kit	(assembled)	1	2.00	0.20	3.00
	Glasses, sun	8465-161-9415	6	1.74	0.30	6.00
	In situ shelter	none	1	NA	NA	NA
	Lipstick, anti-chap	8510-161-6205	12	0.76	0.10	0.48
	Mattress, pneumatic, nylon	8465-254-8887	6	13.99	1.20	39.00
	Poncho	8405-170-9894	6	16.90	0.60	32.40
	Sunburn cream	8510-162-5658	6	1.00	0.30	0.54
Shelter and Protection Subsystem TOTALS				147.49	10.56	356.76
3. Heating (Food and Personnel)						
	Box, match, waterproof	8465-265-4925	6	0.54	0.02	0.78
	Can, gasoline, 5 gal	7240-222-3088	1	9.88	0.90	2.25
	Candles	6260-161-4296	3 lb	3.00	0.20	0.69
	Container, fuel, 1 qt	8110-222-3087	2	0.88	0.20	2.20
	Gasoline, automotive, combat	-	2.5 gal	15.00	NA	0.63
	Matches	9920-128-7662	1 box	0.10	0.03	0.13
	Spout, can, flexible	7240-177-6154	1	1.94	0.10	1.30
	Stove, one burner	7310-285-6155	2	4.24	0.20	9.60
Heating Subsystem TOTALS				35.58	1.65	17.58

APPENDIX 2.2-1/A (cont.)

POMMS 59-A-1

Subsystem	Component	Federal Stock Number	Quantity	Weight	Cube	Cost
4. Food, Food Service, and Sanitation						
	Bag, disposable	(experimental)	1	0.50	0.20	1.00
	Canteen, cold weather, complete	(experimental)	6	15.00	0.30	150.00
	Container, water, 6-in-1	(experimental)	1	4.71	0.66	25.00
	Cookset, mountain	7360-272-2485	2	3.00	0.80	2.50
	SFL Quick-serve Rations	(experimental)	3 cases	99.00	2.40	45.00
Food, Food Service, and Sanitation Subsystem TOTALS				122.21	4.36	223.50
5. Operational Equipment						
	Flares, signal	-	6	3.18	0.40	1.80
	Flashlight	6230-162-1223	1	0.80	0.10	1.30
	Harness for sled	8465-255-8413	6	5.28	0.48	21.00
	Intrenching tool	5120-293-1579	6	14.94	1.20	9.00
	Machete w/sheath	5110-223-6260	3	5.94	0.21	9.06
	Pistol, pyrotechnic, AN-M-8	1095-726-5820	1	1.00	0.10	3.00
	Rope, climbing, nylon	4020-231-2537	1	15.00	0.40	18.10
	Rucksack	8465-261-5000	6	29.94	10.20	120.00
	Sled, scow type, 200 lb	3920-273-8211	2	64.86	20.00	157.50
	Snowshoes, bear paw, wood, solid frame, w/binding	8465-240-2946	6 pr	18.00	1.38	12.40
	Thongs	8465-257-3813	12	0.84	0.12	3.00
Operational Equipment Subsystem TOTALS				159.78	34.59	356.16

APPENDIX 2.2-1/A (cont.)

IDENTIFICATION OF POMMS 59-B-1

SUMMARY LOGISTIC CHARACTERISTICS

Subsystem	Cost ($)		Weight (lb)		Cube (cu ft)	
1. Clothing						
a. Organizational	624.60		203.26		14.28	
b. Personal	102.00		31.93		2.00	
		726.60		235.19		16.28
2. Shelter and Protection		501.76		188.41		13.16
3. Heating (Food and Personnel)*		38.45		155.12		5.95
4. Food, Food Service, and Sanitation**		210.82		169.59		9.76
5. Operational Equipment		356.16		159.78		34.59
TOTALS		$1833.79		908.09		79.74

* Includes basic fuel supply component for 3 days operation.

** Includes basic food supply for 3 days operation

APPENDIX 2.2-1/A (cont.)

POMMS 59-B-1

Subsystem	Component	Federal Stock Number	Quantity	Weight	Cube	Cost
1. Clothing						
	a. Organizational					
	Boot, combat, insulated, cold dry, rubber, white, plain toe, rubber chevron sole and heel	(experimental)	6 pr	31.28	3.30	63.00
	Cap, field, cotton, poplin, wool pile, OG, shade #107	8405-268-8027 thru 8032	6	3.30	0.16	9.60
	Coat, cotton, wind resistant, sateen, water repellent treated, OG, shade #107, slide fastener closure (combat)	8405-255-8583 thru 8591	6	19.93	0.90	69.60
	Gloves, anti-contact	8415-298-1934 thru 1936	6 pr	0.53	0.04	4.50
	Helmet, steel	8415-161-9411	6	13.62	0.38	10.50
	Hood, winter, cotton warp, nylon filled, oxford, OG shade #107	8405-266-7750	6	12.00	0.94	30.90
	Liner, coat, natural, mohair, frieze, 16 oz	8405-261-6591 thru 6594	6	13.86	1.13	48.90
	Liner, helmet, steel	8415-240-2514	6	5.28	0.38	28.80
	Liner, parka, mohair, frieze, natural	8405-240-2460 thru 2463	6	15.71	1.10	63.90
	Liner, trousers, arctic, mohair frieze, natural	8405-261-6845 thru 6853	6	11.88	0.72	45.60
	Mitten, inserts, wool and nylon knit, trigger finger, OD	8415-160-0769 med 8415-160-1379 lge	6 pr	1.30	0.12	5.70
	Mitten set, arctic, cotton, oxford, gauntlet, OD, type 1	8415-268-7690 thru 7693	6 pr	13.20	1.90	51.00
	Parka, cotton, jean, 4.8 oz, white	8405-223-7628	6	10.26	0.58	20.70
	Parka, cotton-nylon, oxford, OG, shade #107	8405-223-7621 thru 7624	6	19.80	0.90	75.90

APPENDIX 2.2-1/A (cont.)

POMMS 59-B-1

Subsystem	Component	Federal Stock Number	Quantity	Weight	Cube	Cost
1. Clothing (cont.)						
	a. Organizational (cont.)					
	Shirt, wool, 16 oz, olive green, shade #108	8405-188-3791 thru 3798	6	9.37	0.90	39.90
	Suspenders, trousers, scissor type back, OG, shade #107	8440-221-0852	6	2.10	0.11	3.90
	Trousers, cotton, jean, 4.8 oz, white	8405-240-6295	6	6.00	0.25	12.30
	Trousers, cotton-nylon, OG, shade #107, M1951	8405-265-0379 thru 0387	6	13.84	0.47	39.90
	TOTALS - Clothing, Organizational			203.26	14.28	624.60
	b. Personal					
	Drawers, ankle length, 50% cotton, 50% wool, ribbed knit, natural	8420-269-5587 thru 5591	12	11.62	0.65	31.80
	Glove, insert, wool, knitted, OD	8415-160-0815 thru 0817	12	0.79	0.09	9.00
	Socks, wool, OD, shade #9, cushion sole, 15" length	8440-264-2923	36 pr	7.20	0.50	19.80
	Undershirt, 50% cotton, 50% wool, full length sleeve	8420-197-2884 thru 2887	12	10.60	0.66	31.20
	TOTALS - Personal Clothing			31.93	2.00	102.00
Clothing Subsystem TOTALS				235.19	16.28	726.60

APPENDIX 2.2-1/A (cont.)

POMMS 59-B-1

Subsystem	Component	Federal Stock Number	Quantity	Weight	Cube	Cost
2. Shelter and Protection						
	Bag, sleeping, arctic	8465-238-8107	6	96.00	7.20	237.30
	Brush, mountain	7920-292-4372	6	0.22	0.06	7.50
	Case, water repellent, bag, sleeping	8465-237-8719	6	14.88	0.60	30.54
	First aid kit	(assembled)	1	2.00	0.20	3.00
	Glasses, sun	8465-161-9415	6	1.74	0.30	6.00
	Lipstick, anti-chap	8510-161-6205	12	0.76	0.10	0.48
	Mattress, pneumatic, nylon	8465-254-8887	6	13.99	1.20	39.00
	Poncho	8405-170-9894	6	16.90	0.60	32.40
	Sunburn cream	8510-162-5658	6	1.00	0.30	0.54
	Tent, hexagonal, lightweight, M1950	8340-269-1372	1	40.92	2.60	145.00
Shelter and Protection Subsystem TOTALS				188.41	13.16	501.76
3. Heating (Food and Personnel)						
	Box, match, waterproof	8465-265-4925	6	0.54	0.02	0.78
	Can, gasoline, 5 gal	7240-222-3088	3	29.64	2.70	6.75
	Candles	6260-161-4296	3 lb	3.00	0.20	0.69
	Container, fuel, 1 qt	8110-222-3087	2	0.88	0.20	2.20
	Gasoline, automotive, combat	-	15 gal	93.00	0.70	2.75
	Matches	9920-128-7662	1 box	0.10	0.03	0.13
	Spout, can, flexible	7240-177-6154	1	1.94	0.10	1.30
	Stove, one-burner	7310-285-6155	2	4.24	0.20	9.60
	Stove, Yukon	4520-287-3353	1	21.78	1.80	14.25
Heating Subsystem TOTALS				155.12	5.95	38.45

APPENDIX 2.2-1/A (cont.)

POMMS 59-B-1

Subsystem	Component	Federal Stock Number	Quantity	Weight	Cube	Cost
4. Food, Food Service, and Sanitation						
	Bag, disposable	(experimental)	1	0.50	0.20	1.00
	Canteen, cold weather, complete	(experimental)	6	15.00	0.30	150.00
	Cookset, mountain	7360-272-2485	2	3.00	0.66	2.50
	Fork	7340-243-5391	6	0.40	0.20	0.72
	Knife	7340-240-7436	6	0.66	0.20	1.20
	Pan, mess kit	7350-242-5110	6	8.40	0.65	7.20
	Ration, small detachment, 5-in-1 (mod. 6-in-1)		6 cases	145.00	8.00	54.00
	Spoon	7340-243-5390	6	0.53	0.20	0.90
Food, Food Service, and Sanitation Subsystem TOTALS				173.49	10.41	217.52
5. Operational Equipment						
	Flares, signal		6	3.18	0.40	1.80
	Flashlight	6230-162-1223	1	0.80	0.10	1.30
	Harness for sled	8465-255-8413	6	5.28	0.48	21.00
	Intrenching tool	5120-293-1579	6	14.94	1.20	9.00
	Machete w/sheath	5110-223-6260	3	5.94	0.21	9.06
	Pistol, pyrotechnic, AN-M-8	1095-726-5820	1	1.00	0.10	3.00
	Rope, climbing, nylon	4020-231-2537	1	15.00	0.40	18.10
	Rucksack	8465-261-5000	6	29.94	10.20	120.00
	Sled, scow type, 200 lb	3920-273-8211	2	64.86	20.00	157.50
	Snowshoes, bear paw, wood, solid frame, w/binding	8465-240-2946	6 pr	18.00	1.38	12.40
	Thongs	8465-257-3813	12	0.84	0.12	3.00
Operational Equipment Subsystem TOTALS				159.78	34.59	356.16

APPENDIX 2.2-1/A (cont.)

IDENTIFICATION OF POMMS 59-C-1

SUMMARY LOGISTIC CHARACTERISTICS

Subsystem	Cost ($)		Weight (lb)		Cube (cu ft)	
1. Clothing						
a. Organizational	624.60		203.26		14.28	
b. Personal	102.00		31.93		2.00	
		726.60		235.19		16.28
2. Shelter and Protection		515.76		185.17		12.60
3. Heating (Food and Personnel)*		22.38		37.70		1.66
4. Food, Food Service, and Sanitation**		189.49		165.76		6.60
5. Operational Equip-ment		356.16		159.78		34.59
TOTALS		$1810.39		783.60		71.73

* Includes basic fuel supply component for 3 days operation.

** Includes basic food supply for 3 days operation.

APPENDIX 2.2-1/A (cont.)

POMMS 59-C-1

Subsystem	Component	Federal Stock Number	Quantity	Weight	Cube	Cost
1. Clothing						
	a. **Organizational**					
	Boot, combat, insulated, cold dry, rubber, white, plain toe, rubber chevron sole and heel	(experimental)	6 pr	31.28	3.30	63.00
	Cap, field, cotton, poplin, wool pile, OG, QM shade #107	8405-268-8027 thru 8032	6	3.30	0.16	9.60
	Coat, cotton, wind resistant, sateen, water repellent treated, OG, QM shade #107, slide fastener closure (combat)	8405-255-8583 thru 8591	6	19.93	0.90	69.60
	Gloves, anti-contact	8415-298-1934 thru 1936	6 pr	0.53	0.04	4.50
	Helmet, steel	8415-161-9411	6	13.62	0.38	10.50
	Hood, winter, cotton warp, nylon filled, oxford, OG, QM shade #107	8405-266-7750	6	12.00	0.94	30.90
	Liner, coat, natural, mohair, frieze, 16 oz	8405-261-6591 thru 6594	6	13.86	1.13	48.90
	Liner, helmet, steel	8415-240-2514	6	5.28	0.38	28.80
	Liner, parka, mohair, frieze, natural	8405-240-2460 thru 2463	6	15.71	1.1	63.90
	Liner, trousers, arctic, mohair, frieze, natural	8405-261-6845 thru 6853	6	11.88	0.72	45.60
	Mitten, inserts, wool and nylon knit, trigger finger, OD	8415-160-0769 med 8415-160-1376 lge	6 pr	1.30	0.12	5.70
	Mitten set, arctic, cotton, oxford, gauntlet, OD, type 1	8415-268-7690 thru 7693	6 pr	13.20	1.90	51.00
	Parka, cotton, jean, 4.8 oz, white	8405-223-7628	6	10.26	0.58	20.70
	Parka, cotton-nylon, oxford, OG, QM shade #107	8405-223-7621 thru 7624	6	19.80	0.90	75.90

APPENDIX 2.2-1/A (cont.)

POMMS 59-C-1

Subsystem	Component	Federal Stock Number	Quantity	Weight	Cube	Cost
1. Clothing (cont.)						
	a. Organization (cont.)					
	Shirt, wool, 16 oz, OG, QM shade #108	8405-188-3791 thru 3798	6	9.37	0.90	39.90
	Suspenders, trousers, scissor type back, OG, QM shade #107	8440-221-0852	6	2.10	0.11	3.90
	Trousers, cotton, jean, 4.8 oz, white	8405-240-6295	6	6.00	0.25	12.30
	Trousers, cotton-nylon, OG, QM shade #107, M-1951	8405-265-0379 thru 0387	6	13.84	0.47	39.90
	TOTALS - Clothing, Organizational			203.26	14.28	624.60
	b. Personal					
	Drawers, ankle length, 50% cotton, 50% wool, ribbed knit, natural	8420-269-5587 thru 5591	12	11.62	0.65	31.80
	Glove, insert, wool, knitted, OD	8415-160-0815 thru 0817	12	0.79	0.09	9.00
	Gloves, shell, leather, M-1949	8415-160-0883 thru 0887	6	1.72	0.10	10.20
	Socks, wool, OD, shade #9, cushion sole, 15" length	8440-264-2923	36 pr	7.20	0.50	19.80
	Undershirt, 50% cotton, 50% wool, full length sleeve, natural	8420-197-2884 thru 2887	12	10.60	0.66	31.20
	TOTALS - Personal Clothing			31.93	2.00	102.00
Clothing Subsystem TOTALS				235.19	16.28	726.60

APPENDIX 2.2-1/A (cont.)

POMMS 59-C-1

Subsystem	Component	Federal Stock Number	Quantity	Weight	Cube	Cost
2. Shelter and Protection						
	Bag, sleeping, arctic	8465-254-9017	6	96.00	7.20	237.30
	Brush, mountain	7920-292-4372	6	0.22	0.06	7.50
	Case, water repellent, bag, sleeping	8465-237-8719	6	14.88	0.60	30.54
	First aid kit	(assembled)	1	2.00	0.20	3.00
	Glasses, sun	8465-161-9415	6	1.74	0.30	6.00
	Lipstick, anti-chap	8510-161-6205	12	0.76	0.10	0.48
	Mattress, pneumatic, nylon	8465-254-8887	6	13.99	1.20	39.00
	Poncho	8405-170-9894	6	16.90	0.60	32.40
	Sunburn cream	8510-162-5658	6	1.00	0.30	0.54
	Tent, mountain, two-man	8340-254-9017	3	37.68	2.40	159.00
Shelter and Protection Subsystem TOTALS				185.17	12.60	515.76
3. Heating (Food and Personnel						
	Box, match, waterproof	8465-265-4925	6	0.54	0.02	0.78
	Can, gasoline, 5 gal	7240-222-3088	1	9.88	0.90	2.25
	Candles	6260-161-4296	3 lb	3.00	0.20	0.69
	Container, fuel, 1 qt	8110-222-3087	2	0.88	0.20	2.20
	Gasoline, automotive, combat	-	5	31.00	0.23	1.25
	Matches	9920-128-7662	1 box	0.10	0.03	0.13
	Spout, can flexible	7240-177-6154	1	1.94	0.10	1.30
	Stove, one-burner	7310-285-6155	3	6.36	0.30	14.40
Heating Subsystem TOTALS				37.70	1.66	22.38

APPENDIX 2.2-1/A (cont.)

POMMS 59-C-1

Subsystem	Component	Federal Stock Number	Quantity	Weight	Cube	Cost
4. Food, Food Service, and Sanitation						
	Bag, disposable	(experimental)	1 case	0.50	0.20	1.00
	Canteen, cold weather, complete	(experimental	6	15.00	0.30	150.00
	Cookset, mountain	7360-272-2485	3	4.50	1.00	3.75
	Meal, combat, individual	(experimental)	6 cases	143.76	5.10	34.74
Food, Food Service, and Sanitation Subsystem TOTALS				165.76	6.60	189.49
5. Operational Equipment						
	Flares, signal	-	6	3.18	0.40	1.80
	Flashlight	6230-162-1223	1	0.80	0.10	1.30
	Harness for sled	8465-255-8413	6	5.28	0.48	21.00
	Intrenching tool	5120-293-1579	6	14.94	1.20	9.00
	Machete w/sheath	5110-223-6260	3	5.94	0.21	9.06
	Pistol, pyrotechnic, AN-M-8	1095-726-5820	1	1.00	0.10	3.00
	Rope, climbing, nylon	4020-231-2537	1	15.00	0.40	18.10
	Rucksack	8465-261-5000	6	29.94	10.20	120.00
	Sled, scow type, 200 lb	3920-273-8211	2	64.86	20.00	157.50
	Snowshoes, bear paw, wood, solid frame, w/binding	8465-240-2946	6 pr	18.00	1.38	12.40
	Thongs	8465-257-3813	12	0.84	0.12	3.00
Operational Equipment Subsystem TOTALS				159.78	34.59	356.16

APPENDIX 2.3-1/A

QM R&E CENTER LABORATORIES
POLAR PROJECT NO. 1
GREENLAND

Qualification Requirements for Project Personnel

A. ESSENTIAL REQUIREMENTS

1. Physical.

a. General. Because of the rigorous climate and limited facilities in polar regions, the examining physician shall be informed that personnel must be in good physical condition for this type of environment. Common colds, respiratory ailments, or any other conditions characterized by lowered physical resistance may result in complications in polar climates. Personnel will have a physical examination prior to departure. The physical examination must be more than a routine one, such as is customary for most types of duty. Potential problems, such as orthopedic disability, psychiatric liability, etc. must be singularly evaluated by the examining physician, and if borderline or doubtful, personnel should be disqualified.

b. Criteria. The following physical criteria should be observed in qualifying personnel for Project No. 1:

(1) PULHES Scale Rating of 1.

(2) Maximum height of 6 feet.

(3) No abnormalities which may influence blood flow to the hands and feet.

(4) No chronic organic sinusitis.

(5) No skin hypersensitivity to sun or wind, or history of lip-line exposure sores.

(6) No history of frostbite or heat exhaustion.

(7) No artificial limbs, braces, or false eyes.

(8) No varicose veins including hemorrhoids.

(9) No perforations of ear drums or deviated nasal septa.

(10) No trick knees or flat feet.

APPENDIX 2.3-1/A (cont.)

(11) No abnormalities of the back or spine.

(12) No skin disorders other than mild athlete's foot.

(13) No personality defects, such as antisocial or psychotic tendencies (including alcoholism) which in the opinion of the examining officer would make assignment of this nature inadvisable. (Provision is to be made for administration of Minnesota Multiphasic Personality (Modified)).

(14) Chest X-ray within 30 days.

(15) No circulatory ailments.

(16) Any medical or dental defects which might reasonably be expected to require care during their tour of duty will be corrected prior to departure.

2. Aptitudes.

a. GCT score of 95 or above.

b. Minimum score of 100 in Aptitude Area IN.

c. Minimum score of 100 in Aptitude Area GM.

d. Minimum score of 100 in Aptitude Area MM.

e. Minimum score of 95 in Aptitude Area CL.

f. Minimum score of 100 in Aptitude Area GT.

3. Education.

a. Military.

Must have completed at least one MOS course.

b. Civilian.

Must have completed high school.

4. Service.

Minimum service - 18 months. At least 6 months or more of active duty remaining after 15 September 1959. Maximum service - 12 years.

5. <u>Rank</u>. PFC to M/SGT.

6. <u>Voluntary Participation</u>.

All men must be volunteers.

B. DESIRABLE REQUIREMENTS.

One or more of the following are highly desirable but are not to be considered essential:

1. <u>Military Education</u>.

a. Completion of Arctic Indoctrination Course.

b. Completion of Mountain Cold Weather Training Course.

c. Completion of Mountain Training School Course, 8147th Army Unit in Japan.

d. Completion of Mountain Training School Course, Camp Saalfolden, Austria.

2. <u>Military Experience</u>.

a. Winter training experience with 1st Cavalry Division or other Army element, Hokkaido, Japan, (1953-1954-1955).

b. Experience with QM cold weather clothing and equipment.

3. <u>Civilian Experience</u>.

a. Some familiarity with arctic, subarctic or polar areas.

b. Some experience in arctic living and exploration.

APPENDIX 2.5-1/A

LIST AND CODE DESIGNATION OF CONTROL TASKS

CONTROL TASK CODE NO. R-1

1. Task Title: Rest Accommodation.

2. Object: To obtain information on factors which influence the adequacy of systems of materiel to provide rest accommodations for small groups.

3. Materiel:

   a. Equipment.

      (1) POMMS 59-A-1.

      (2) POMMS 59-B-1.

      (3) POMMS 59-C-1.

   b. Special Apparatus.

      (1) Thermograph Recorder.

      (2) Support instrumentation used in QM Polar Project 59-4 (Micrometeorology) (See Task E-7).

4. Procedure:

   a. The period from 2200 hours of one day to 0600 hours the following day will be used as a sleep-rest regime to be carried out daily during operational period of each Task Team at its designated Microlog Station Area.

b. Limitations to be applied are as follows:

(1) Sleeping protection - Limited to Bag, Sleeping, Mountain, Mattress Pneumatic Nylon; and Poncho. Sleeping space is allocated.

(2) Body clothing - To be selected by Task Team Leader.

(3) Fuel and ration consumption - None.

(4) Period - 8 hours from 2200 to 0600.

(5) No smoking in sleeping bags.

(6) Group equipment is stored in standard arrangement.

c. Activities during this task shall include the following:

(1) Preparation of sleeping arrangement and related equipment.

(2) Sleep-rest regime.

5. Results:

a. Observations

(1) Record of clothing used in connection with sleeping protection.

(2) Record sleeping arrangement or pattern.

(3) Record space restriction or limitation.

(4) Record total weight of components observed in (1) above for Task Team Group.

(5) Photographic record of the above.

b. Measurements

(1) Ambient temperature and wind velocity for period.

(2) Shelter temperature for period.

(3) Relative humidity of shelter.

c. Subjective Reactions

Questionnaires will be prepared for use by Task Team members, to develop general information regarding compatibility of rest accommodation equipment and to obtain an evaluation of the quality of rest obtained.

CONTROL TASK CODE NO. H-2

1. Task Title: Habitability (morning).

2. Object: To determine operational factors and equipment which influence the requirements for small group living on the Ice Cap.

3. Materiel:

a. Equipment.

(1) POMMS 59-A-1.

(2) POMMS 59-B-1.

(3) POMMS 59-C-1.

b. Special Apparatus.

(1) Stop watches.

(2) Thermometer 0 to 212F (metal element, dial type).

(3) Support instrumentation (Micrometeorological project QM Project 59-4) (See Task E-7)

4. Procedure:

a. The period from 0600 to 0730 hours will be used as a habitability-personal preparation, camp preparation and food preparation, and food service regime to be carried out daily during operational period of each Task Team at its designated Microlog Station Area.

b. Limitations to be applied.

(1) Group routine will be established for each team.

(2) Habitability duties will be rotated between personnel on a roster basis.

(3) Food consumption - Limited to proportionate share based on 4800-calorie ration/man/day.

(4) Fuel consumption - Limited to requirements of food preparation and snow melting.

(5) Body clothing - Prescribed by Team Leader.

c. <u>Activities</u> during this task shall include the following:

(1) Personal preparation and group sanitation (including donning of clothing and washing).

(2) Food service functions (including food preparation, service and consumption, and sanitation)

(3) Sanitation functions (including use of disinfectant and procedures as determined by station controllers).

5. Results.

a. <u>Observations</u>.

(1) Record and identification of equipment and supplies used and adequacy for each activity.

(2) Ease of use, operation, maintenance and sanitation of equipment and supplies during each activity.

(3) Record of food items issued but not consumed.

(4) Number of personnel occupied - Food preparation.

(5) Record of clothing used.

(6) Manner of food serving and consumption.

(7) Condition of latrine and garbage pits.

(8) Photographic record.

b. <u>Measurements</u>.

(1) Time required for completion of Habitability Task.

(2) Time required for each activity.

(3) Ambient temperature.

(4) Wind speed and direction.

(5) Quantity of fuel used.

(6) Quantity of food consumed.

(7) Time required to prepare 180 F water from melting snow.

(8) Quantity of water produced.

c. Subjective reactions.

Questionnaires will be prepared for use by Task Team members to develop general information regarding compatibility of equipment and supplies to obtain an evaluation of the degree of acceptance of equipment and food items.

CONTROL TASK CODE NO. O-3

1. Task Title: Operational (logistics).

2. Object:

a. To investigate operational performance factors which influence the support requirements of systems of equipment for small groups.

b. To determine the influence of type of logistical support on the ability of small groups to perform prescribed tasks.

3. Materiel:

a. Equipment.

(1) POMMS 59-A-1.

(2) POMMS 59-B-1.

(3) POMMS 59-C-1.

b. Special Apparatus.

(1) Stop watches.

(2) Support instrumentation (Micrometeorological project) (see Task E-7).

4. Procedure:

   a. The period from 0730 to 1730 will be used as a period during which Task Teams will follow a prescribed routine of activities: withdrawing from camp site, loading all equipment and supplies on sleds, marching 10 miles, and establishing a new camp site.

   b. Limitations to be applied are as follows:

      (1) Shelter for POMMS 59-A-1 when evaluated shall be left intact.

      (2) Load for trail shall be selected from designated ration comprising each POMMS by Task Team Leader

      (3) Clothing to be worn by Task Team shall be designated by Task Team Leader.

      (4) Group routing for packing each sled shall be established.

      (5) Garbage and latrine pits shall be covered and marked.

      (6) Snowshoes shall be used for march.

   c. Activities for each team during this task shall include the following:

      (1) Loading all assigned equipment and supplies on sleds.

      (2) Oversnow movement of 10 miles hauling sleds using snowshoes.

      (3) Preparation of meal on trail.

      (4) Establishment of camp site (including erection and/or construction of shelter, construction of snow wall-windbreak around a tent shelter, constructing latrine, digging garbage pit, and allocating space for equipment and personnel within shelter(s).

5. Results.

   a. Observations

      (1) Record routine in striking camp.

      (2) Record sled-loading procedure and load distribution.

      (3) Record routine in erecting camp.

      (4) Record group procedure on march.

      (5) Record trail food preparation, eating procedure, food consumed and equipment used.

(6) Record clothing items removed during movement, order of removal, and manner of carrying after removal.

(7) Record number of breaks.

(8) Rate quality of camp site establishment.

(9) Photographic record.

b. Measurements.

(1) Time required to strike camp, load sled, and prepare for march.

(2) Time of departure from site.

(3) Distance and time of march between breaks.

(4) Time of each break including eating break.

(5) Time of arrival at new site.

(6) Time required to prepare and establish new campsite.

c. Subjective reactions.

Questionnaires will be prepared for use by Task Team members to develop general information regarding compatibility of equipment systems and to obtain an evaluation of the degree of acceptance of equipment to perform task.

CONTROL TASK CODE NO. 0-4

1. Task Title: Operational (tactical).
   (Dismounted Oversnow Movement and Small Group Snow Construction Techniques)

2. Object: Same as Control Task No. 0-3.

3. Materiel: Same as Control Task No. 0-3.

4. Procedure:

a. The period from 0730 to 1730 will be used as a period during which Task Team will follow a prescribed routine of activities involving a march to a prescribed area, construction of a snow shelter and a return march to established camp site.

b. Limitations to be applied are as follows:

(1) Load-carrying equipment will be limited to rucksack.

(2) Minimum load per rucksack shall be 20 pounds.

(3) Maximum load per individual shall not exceed 30 pounds including operational equipment.

(4) Snowshoes shall be worn.

c. Activities for each team during the task shall include the following:

(1) Loading all required equipment and supplies for activities during this task in rucksacks and preparation for march.

(2) Oversnow movement of 5 miles to area designated by station controller.

(3) Preparation of trail meal.

(4) Small group snow construction technique in accordance with specifications furnished by station controller.

(5) Oversnow movement of 5 miles to established camp site.

5. Results.

a. Observations.

(1) Record loading procedure and load distribution.

(2) Record group procedure on march.

(3) Record clothing items removed during movements, order of removal and manner of carrying after removal.

(4) Record number of breaks.

(5) Record food preparation, eating procedure, food consumed, and equipment used.

(6) Rate quality of construction product.

(7) Record construction procedure and technique.

(8) Photographic record.

b. Measurements.

(1) Time required to load equipment and prepare for march.

(2) Time of departure from camp site.

(3) Distance and time of march between breaks including eating break.

(4) Time of arrival at construction site.

(5) Time of start and completion of specified snow construction technique task.

(6) Time of departure from construction site.

(7) Time of arrival at established camp site.

c. Subjective Reactions.

Same as Control Task No. 0-3.

CONTROL TASK CODE NO. H-5

1. Task Title: Habitability (evening).

2. Object: Same as for Control Task Code No. H-2.

3. Materiel: Same as for Control Task Code No. H-2.

4. Procedure:

a. The period from 1730 hours to 1900 hours will be used as a habitability - personal preparation, camp preparation, and food preparation and food service regime to be carried out daily during operational period of each Task Term at its designated Microlog Station Area.

b. Limitations to be applied.

Same as for H-2 except that fuel consumption may be extended to provide heated water for shaving and shelter heat to maximum average temperature of plus 50F.

c. Activities: Same as for Control Task Code No. H-2.

Results: Same as for Control Task Code No. H-2.

CONTROL TASK CODE NO. R-6

1. Task Title: Rest and Record.

2. Object: To provide a daily control period during which the Control Group and Task Group personnel comprising QM Project 59-1 may complete miscellaneous activities and planning.

3. Materiel.

   a. Equipment.

      (1) POMMS 59-A-1.

      (2) POMMS 59-B-1.

      (3) POMMS 59-C-1.

   b. Special apparatus and supplies.

      (1) Thermograph recorder.

      (2) Support instrumentation used in QM Polar Project 59-4 (Micrometeorology) (See Task E-7).

      (3) Administrative supplies (including Team Log Book, Individual Log Book, Questionnaires).

4. Procedure.

   a. The period from 1900 hours to 2200 hours will be used as a period during which Task Team Groups will complete miscellaneous activities including orientation, planning conduct of following day's tasks and completing log book entries and questionnaires.

   b. Limitations to be applied are as follows:

      (1) Snack items only from designated rations per day may be consumed.

      (2) Fuel consumption for heating may be used up to quantity rationed per day.

      (3) Questionnaires will be completed before Team and Individual Log Book entries.

      (4) Team and Individual Log Book entries will be completed prior to all other miscellaneous activities during this task.

c. Activities during this task shall include the following:

(1) Completion of Questionnaires furnished by station controller.

(2) Completion of Team and Individual Log Book entries.

(3) Miscellaneous Activities as determined by Task Team.

5. Results:

a. Observations.

(1) Morale.

(2) Ration components selected for snack.

(3) Record miscellaneous activities engaged in by Task Team.

b. Measurements.

(1) Fuel consumption.

(2) Shelter temperature and relative humidity.

(3) Ambient temperature and wind velocity.

6. Addendum:

Although not necessarily a part of this task, nude weights on all men shall be logged at the beginning and end of each period of operation. Total weight shall be logged in Team Log Book and weights of team members will be logged in individual log book.

CONTROL TASK CODE NO. E-7.

1. Task Title: Environmental.

2. Object: To determine the environmental conditions affecting each of the 3 personnel-materiel complexes and to determine the degree to which each element of the total environment influences the effectiveness of the personnel-materiel complexes.

3. Operations to be conducted.

   a. Obtain measurements of the temperature regime and of other environmental conditions in living quarters of the 3 groups during periods of occupancy and while vacant, and correlate these measurements with ambient conditions and with types of equipment and methods of operation of each complex.

   b. Obtain wind and temperature measurements and make other visual weather observations as required during control task periods when test teams are engaged in outdoor activities.

   c. Obtain observations of thermal and other environmental conditions within storage pits, tunnels or buildings.

   d. Provide other meteorological support as required for QM Program.

4. Personnel (same individual attached to QMC Polar Project 59-4).

5. Application: This task is applicable to all task activities: R-1. H-2, 0-3, 0-4, H-5, R-6.

APPENDIX 2.7-1/A

QUESTIONNAIRES USED FOR 59-1

APPENDIX 2.7-1/A

____
(your name)

PRE-QUESTIONNAIRE

Introduction:

During this exercise you are expected to judge the usefulness of equipment and supplies and to help determine whether the procedures being used are working out all right or not. In such a situation it is necessary to know something about the people doing the judging. Thus the purpose of this questionnaire is to enable you to report your general attitudes and feelings about the exercise and about other people you may be working with.

---

1. At the right check the main reasons why you volunteered for this Greenland operation. Use the space below to comment on how these reasons apply to yourself.

   COMMENTS:

- ☐ outdoor life
- ☐ scientific interest
- ☐ good fellowship
- ☐ personal challenge
- ☐ duty and promotion
- ☐ other personal benefit
- ☐ plain curiosity
- ☐ some other reason

---

2. At the bottom of this form is a LEVELS scale. In the box at the right, write the number from the LEVELS scale which best shows your present level of interest and desire toward going out on this Greenland Ice Cap operation for the next six weeks. ☐

---

3. Fifteen enlisted volunteers have been selected for this operation. At the right list the last names of four men who you suppose may be the most observant and critical judges of good and bad points about supplies, equipment, and procedures.

   1. ______________
   2. ______________
   3. ______________
   4. ______________

---

4. As you know, 6-man teams (5 E.M.'s and 1 officer) will be formed to work together. List the last names of 5 men you would pick to make up the 6-man team you would most prefer to be on.

   1 __________ 2 __________ 3 __________ 4 __________ 5 __________

APPENDIX 2.7-1/A (cont.)

5.a At the right, list names of 4 men, from among the 15 E.M.'s, who you suppose might be expected to perform quite well by themselves on the Ice Cap under most conditions.

1. ________
2. ________
3. ________
4. ________

5.b Now list the names of 4 men from among the 15 E.M.'s, who you suppose might not perform quite so well by themselves on the Ice Cap under most conditions.

1. ________
2. ________
3. ________
4. ________

6.a At the right, list names of 4 men from among the 15 E.M.'s, who you think may tend to be usually more considerate, affectionate, and helpful towards others.

1. ________
2. ________
3. ________
4. ________

6.b In the spaces just below, list names of 4 men, from among the 15 E.M.'s, who you think may tend to be usually <u>less</u> considerate, affectionate, and helpful towards others.

1 ________ 2 ________ 3 ________ 4 ________

7.a Name 4 men, from among the 15 E.M.'s, who seem most quiet and least talkative.

1. ________
2. ________
3. ________
4. ________

7.b Now in the space below name the 4 men, from among the 15 E.M.'s, who seem most talkative and least quiet.

1 ________ 2 ________ 3 ________ 4 ________

---

8. At the right list the names of 4 men, from among the 15 E.M.'s, who you think may become most popular and well-liked during the 6-week operations.

1. ________
2. ________
3. ________
4. ________

9.a Some people resemble each other because they tend to like to do similar things and to have the same interests, beliefs, and backgrounds. Name the 4 men, from among the 18 E.M.'s and officers, who you would consider possibly most similar to yourself.

1. ____________
2. ____________
3. ____________
4. ____________

9.b Now in the spaces below name 4 men, from among the 18 E.M.'s and officers, who you consider possibly least similar to yourself.

1 ____________ 2 ____________ 3 ____________ 4 ____________

---

10. Please give the following information:

a. Your age ____________

b. Your father's regular occupation during most of his working life

____

c. Name of the state you lived in mostly before age 16

____

d. Number of years you went to school ____________

e. Before age 16, were you living mostly in cities or mostly in small towns and the country?
___Cities ___Towns & country

f. What are the ages of your living brothers and sisters (if you have any)?
____________ none ____

g. How old were you when you first went alone on a trip of over 100 miles? ____________

h. How old were you when you earned your first money (except from a relative or family friend) for some work you did? ____________

i. What were you doing during the month or two before you originally entered the Army?

The LEVELS scale:

1	2	3	4	5	6	7
Zero level	Very low level	Rather low level	Moderate level	Rather high level	Very high level	Extremely high level

CAC Form T-726
22 Jun 59

Operation Crystal Key I
Project 59-1

DIARY REPORT

NAME ______________________________ CYCLE ____________

DATE ______________________________ PERIOD ____________

On the next page are listed a number of general areas where you may have personal comments or opinions to offer on, for example, different types of equipment, types of activities or kinds of experiences. These listings are just reminders to make you think about each topic and decide whether you have something to say about it. Go through the check lists without hurrying, pausing a moment with each heading to decide whether you have any comment. Consider all the different headings and check "Comment" or "No Comment" after each. Then turn to the blank pages following and write down each of your comments one-by-one, identifying each comment by its heading number. Take your time; at least 40 minutes is allowed for completion of this Report.

The information you supply in this Diary Report and other questionnaires must be frank and complete. To make it easy for you honestly to supply the full information required, security measures covering privacy of your information have been set up. Comments you make in these reports will be seen only by scientific personnel of the Quartermaster Research & Engineering Command and will <u>not</u> be seen by any other persons or officials regardless of rank or position. To further assure privacy you are asked not to discuss your reports and comments during the Operation with anyone except the scientist-observers in charge.

CAC Form
16 June 1959 (T) 725

1
Part 1a (Checklist)

Go through the following check list and decide whether or not you have comments to make in regard to each topic or class of equipment listed. Indicate "Comment" or "No Comment" on each by checking the right box; do not leave any item unchecked. Remember that your comments may be about the quality of an item as well as about its performance or the way it is used; also, both favorable comments and criticisms are important. Generally speaking, you should base your comments on what you have observed, thought and felt about your experiences since the last time you completed this Diary.

	Comment	No Comment
1. CLOTHING & FOOTWEAR		
a) Inner garments	☐	☐
b) Outer garments	☐	☐
c) Handwear	☐	☐
d) Footwear	☐	☐
e) Headgear	☐	☐
2. SHELTER		
a) Tents	☐	☐
b) Heating	☐	☐
c) Sleeping bags	☐	☐
d) Other items	☐	☐
3. FOOD		
a) Packaging	☐	☐
b) Cooking	☐	☐
c) Likes & Dislikes	☐	☐
d) Trail lunches	☐	☐
e) Other eating aspects	☐	☐

	Comment	No Comment
4. a) WATER supply	☐	☐
b) WATER heating	☐	☐
5. TRANSPORT EQUIPMENT		
a) Sledges	☐	☐
b) Pack boards, etc.	☐	☐
6. HAND TOOLS	☐	☐
7. OTHER & MISCELLANEOUS EQUIPMENT	☐	☐
8. EQUIPMENT NOT AVAILABLE BUT NEEDED	☐	☐

2
Part 1b

This page and the following three pages are for your comments on the checked items. Identify each item you comment on with its number and letter (for example: 2 d) and separate comments on different items by drawing horizontal lines between them.

ITEM No.	COMMENTS

Part IIa (Checklist)

This second list concerns more general aspects of your activities. It is different from the first list because the topics do not necessarily involve equipment. Here again you are to base your comments on your experience and on what you have observed, thought and felt since the last time you completed this Diary Report.

	Comment	No Comment
8. PERSONAL		
a) Weather	☐	☐
b) Hunger	☐	☐
c) Thirst	☐	☐
d) Cold	☐	☐
e) Overheating	☐	☐
f) Health	☐	☐
g) Tiredness, wearyness	☐	☐
h) Other	☐	☐
9. GROUP		
a) Leadership	☐	☐
b) Abilities of group members	☐	☐
c) Cooperation among group members	☐	☐
d) Work sharing of duties, chores	☐	☐

	Comment	No Comment
10. GENERAL		
a) Arguments, disagreements	☐	☐
b) Odd happen-ings	☐	☐
c) Good laughs	☐	☐
d) Foul-ups, goof-ups and snafus	☐	☐
11. ANYTHING ELSE	☐	☐

Part IIb (Comments) 7

This page and the following two pages are for your comments on the items you checked in Part IIa. Identify each item you comment on with its number and letter and separate comments on different items by drawing horizontal lines between them.

Item No.	Comments

APPENDIX 2.7-1/A (cont.)

Operation Crystal Key I
Project 59-1

GENERAL INFORMATION QUESTIONNAIRE

NAME ______________________________ PERIOD ________

DATE ______________________________ CYCLE ________

Answers to these questions are to be based on your past week's experiences and observations. The purpose of the questionnaire is to get your views and opinions about the equipment used and about how operations are going. Consider each question carefully and answer to the best of your ability. Remember, it is your personal opinions that are needed. Remember, also, that no one will see your answers except scientific personnel who analyze test results.

NOTES ON GOOD FEATURES:

1a. In this space note briefly what you consider to be the main good points and advantages of this past week's equipment system.

- -

NOTES ON BAD FEATURES:

1b. Now note briefly what you consider to be the main bad points and disadvantages of this past week's equipment system.

MISSING

2a. What needed items of equipment or supplies were missing from this past week's issue?

- -

EXCESS

2b. What unnecessary or excess items of equipment were included in this past week's issue?

---

3. At the end of this form is the same LEVELS scale which you used before on a previous questionnaire. In the box at right, write the number from the LEVELS scale which shows your best estimate of your own group's level of performance in operations and activities during this past week. ☐

ARGUMENTS

4. Concerning which aspects of this past week's duties and activities has there tended to be most argument and disagreement in your group?

5. Using the LEVELS scale, write a number in the box at right which best shows your own <u>level of satisfaction</u> at being with your present group.

ERRORS

6. In the space at the right, note or list what wrong decisions, errors and mistakes you noticed were made in your group during this past week.

7. In the spaces at the right, list the five members of your group in the order in which you have worked with them most closely during this past week.

MOST CLOSELY

____

____

____

____

LEAST CLOSELY ____________________

HAPPENINGS

8. Note and comment briefly on any odd, interesting or unusual happenings that occurred to you or other members of the group during this past week.

PERFORMANCE

9. In any order, list the five members of your group. In the box after each name write a number from the LEVELS scale which best shows your estimate of each person's level of performance during this past week.

______ ☐
______ ☐
______ ☐
______ ☐
______ ☐

PLEASANT

10a. What aspect(s) of this past week's regular duties and activities have you personally found most pleasant and enjoyable?

UNPLEASANT

10b. What aspect(s) of this past week's regular duties and activities have you personally found most unpleasant and distasteful?

LIKING

11. List the five members of your group in any order. After each name write a number from the LEVELS scale which best shows your own level of liking for each person as a good friend.

______ ☐
______ ☐
______ ☐
______ ☐
______ ☐

12.* With whom on your team did you share the 2-man tent when it was issued?

______
Name(s)

*See Table 3.3.4-1

PERFORMANCE

13a. Did you note any changes in your group's performance during the past 3 weeks?

☐ STAYED ABOUT THE SAME
☐ GOT WORSE
☐ IMPROVED

13b. Please comment on your answer to question 13a. COMMENTS

14a. During the past 3 weeks your group has used 3 different systems of equipment. Which of these systems, in your opinion, seemed to work out best.....that is, helped your team to work most efficiently?
WHY?

SYSTEM (specify)

14b. Which system, in your opinion, worked out poorest..... that is, caused your group to be least efficient?
WHY?

SYSTEM (specify)

14c. Which system did you personally like best?
WHY?

SYSTEM (specify)

15. In the spaces at the right, list the 5 other members of your group in order according to the amount of weight and influence the opinions and ideas of each have had on the group as a whole.

MOST WEIGHT & INFLUENCE

____

____

____

____

LEAST WEIGHT & INFLUENCE __________

16. The LEVELS scale appears at the bottom of the page. In any order, list the five other members of your group. In the box after each name, write a LEVELS scale number showing your own level of preference to have that person on another team with you again.

LEVEL OF PREFERENCE

__________ ☐

__________ ☐

__________ ☐

__________ ☐

__________ ☐

The LEVELS scale:

1	2	3	4	5	6	7
Zero level	Very Low level	Rather Low level	Moderate level	Rather High level	Very High level	Extremely High level

CAC Form T-727b
22 Jun 59

APPENDIX 2.7-1/A (cont.)

FOOD QUESTIONNAIRE

Name____________________

Cycle____________

Period____________

Ration____________

This questionnaire is designed to get information about the ration you have been using during the past week. We are interested in each person's own opinions and experiences. Therefore, in answering the questions on the following pages, you are urged to give your own ideas and observations, and to say what you like and don't like. Don't worry if somebody else doesn't agree with you - there are no right or wrong answers.

Please do not discuss the questions with anybody else while filling out the questionnaire.

1. First, we would like to know how much you liked or disliked each of the foods in the ration. Give this information by using the rating scales on the following pages. All of the foods in the ration you have been using are listed. Consider each one in turn and indicate how much you liked or disliked it by circling one of the phrases to the right. If you did not eat a food during the week, circle "Not Tried" to the left of the food name.

CAC Form (T) 724
15 JUNE 1959

APPENDIX 2.7-1/A (cont.)

X		9	8	7	6	5	4	3	2	1
not tried	Chicken and gravy	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
not tried	Beef with gravy	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
not tried	Peaches	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
not tried	Shoestring potatoes	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
not tried	Jam	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
not tried	Chocolate fudge bar	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
not tried	Tomato soup	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
not tried	Tuna fish	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
not tried	Ham & eggs	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
not tried	Pears	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely

CAC Form
21 JULY 58 12 - 455

(5-in-1) 2a

APPENDIX 2.7-1/A (cont.)

X		9	8	7	6	5	4	3	2	1
not tried	Pecan roll	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
not tried	Beans w/pork, tomato sauce	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
not tried	Peanuts	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
not tried	Cheese	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
not tried	Coffee	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
not tried	Vanilla cookie	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
not tried	Frankfurters	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
not tried	Luncheon meat	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
not tried	Chicken noodle soup	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
not tried	Corn	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely

CAC Form
21 JULY 58 12 - 455

(5-in-1) 2b

APPENDIX 2.7-1/A (cont.)

X		9	8	7	6	5	4	3	2	1
not tried	Applesauce	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
not tried	Cereal blocks	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
not tried	Cocoa	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
not tried	Gum	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
not tried	Starch jelly bars	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
not tried	Carmel nouget bar	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
not tried	Meat balls and spaghetti	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
not tried	Pound cake	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
not tried	Peas	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
not tried	Tomatoes	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely

CAC Form
21 JULY 58 12 - 455

(5-in-1) 2e

APPENDIX 2.7-1/A (cont.)

X		9	8	7	6	5	4	3	2	1
not tried	Green beans	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
not tried	Beans with pork, sweet sauce	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
not tried	Bacon	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
not tried	Fruit cake	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
not tried	Peanut butter	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
not tried	Vanilla cream bar	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
not tried	Vegetable-beef soup	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
not tried	Chocolate disc	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
not tried	Kidney beans with ham	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
not tried	Sausage links	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely

CAC Form 21 JULY 58 12 - 455

(5-in-1) 2d

APPENDIX 2.7-1/A (cont.)

X		9	8	7	6	5	4	3	2	1
not tried	Bread	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
not tried	Apricots	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
not tried	Pan-coated chocolate discs	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
not tried	Pineapple	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
not tried	Pork & gravy	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
not tried	Fruit cocktail	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
not tried	Beef and vegetables	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
not tried	Lima beans	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
not tried	Ham & gravy	like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely
not tried		like extremely	like very much	like moderately	like slightly	neither like nor dislike	dislike slightly	dislike moderately	dislike very much	dislike extremely

CAC Form
21 JULY 58 12 - 455

(5-in-1) 20

2. Were there any foods which you particularly disliked? If so, please list them below and briefly state, for each one, why you didn't like it.

3. In general, how well was the food prepared? (Circle one answer)

VERY GOOD GOOD FAIR POOR VERY POOR

4. (a) On the whole, did you get tired of this ration or did you continue to like it about the same throughout the week?

GOT TIRED OF IT LIKED IT ABOUT THE SAME

(b) What particular foods, if any, did you like at first but got tired of later? List below.

5. In your opinion, how good is this ration for the conditions under which it is being used?

VERY GOOD GOOD FAIR POOR VERY POOR

6. How often did you eat or drink something between supper and breakfast?

EVERY DAY   NEARLY EVERY DAY   JUST A FEW TIMES   NEVER

What were the main items which you ate or drank during this time. List below:

7. (a) How often did you have trouble in getting enough liquids to drink?

OFTEN   AT CERTAIN TIMES   NEVER

(b) If so, when did this happen?

(c) How much plain water did you drink?

QUITE A LOT   SOME   VERY LITTLE   NONE

8. At any time during the week, did you have any physical symptoms or distress which you feel was caused by the foods or beverages? If so, briefly describe in the space below. If not, write "none."

9. Did you serve as cook during the week? YES NO If so, how many meals did you prepare?______

10. If you served as cook, answer the following:

(a) Did you have any trouble heating the foods? YES NO If so, briefly describe.

(b) Did you have any trouble preparing soups or beverages? YES NO If so, briefly describe.

(c) Did you have any trouble opening cans or packages? YES NO If so, briefly describe.

(d) Was the can opener satisfactory? O.K. NOT O.K.

(e) Did you have enough equipment to do a proper job? YES NO
If not, what else do you think should be provided?

(5-in-1) 5

APPENDIX 2.7-1/A (cont.)

Food Questionnaire - Answer only at the end of each Cycle.

Now that you have used all three of the rations (Quick Serve, Meal Combat, and 5-in-1) you are asked to compare them on the following four points. Write the names of the rations in the spaces to the right of each question.

1. Which ration provided the best foods, i.e., the foods that you liked most?	BEST ____________
	NEXT BEST ____________
	POOREST ____________
2. Which ration was easiest to prepare?	EASIEST ____________
	NEXT EASIEST ____________
	HARDEST ____________
3. Which ration gave the most over-all satisfaction, i.e., the most "well-fed" feeling?	MOST ____________
	NEXT MOST ____________
	LEAST ____________
4. Considering everything, which ration would you consider most satisfactory for use under conditions of this exercise?	MOST SATISFACTORY ____________
	NEXT MOST SATISFACTORY ____________
	LEAST SATISFACTORY ____________

APPENDIX 3.2.4-1/A

AVERAGE PREFERENCE RATING AND PERCENT EATEN
FOR EACH FOOD ITEM IN EACH CYCLE
AND COMBINED OVER BOTH CYCLES FOR:

APPENDIX 3.2.4-1/A

5-IN-1
AVERAGE PREFERENCE RATING AND PERCENT EATEN
FOR EACH FOOD ITEM IN EACH CYCLE AND
COMBINED OVER BOTH CYCLES

Item	First Cycle			Second Cycle			Cycles Combined	
	N	Rating	% Eaten	N	Rating	% Eaten	Rating	% Eaten
Main Dishes								
Ham & gravy	17	5.47	18	12	6.17	73	5.76	43
Beef & vegetables	17	7.29	94	12	7.25	63	7.28	78
Pork & gravy	17	4.59	42	11	5.45	75	4.93	50
Chicken & gravy	13	7.00	83	12	7.08	60	7.04	71
Beef w/gravy	17	6.00	86	12	6.25	88	6.10	87
Tuna fish	17	6.59	67	12	7.58	88	7.00	76
Ham & eggs	17	5.53	68	11	7.45	68	6.29	68
Beans w/pork & tomato sauce	15	6.47)	71	11	6.91)	89)	6.65	78
Beans w/pork & sw. sauce	15	6.20)		12	6.75)	)		
Frankfurters	16	5.81	78	12	6.50	100	6.11	87
Luncheon meat	16	6.75	93	12	7.67	100	7.14	95
Meat balls & spaghetti	17	7.41	94	12	7.92	100	7.62	96
Bacon	12	6.25	36	11	6.36	31	6.30	34
Kidney beans w/ ham	15	6.93	75	12	6.92	100	6.93	85
Sausage links	15	6.53	75	12	7.42	94	6.93	84
Class Average		6.32	72		6.91	78	6.58	74
Side Dishes								
Tomato soup	16	7.44	100	11	8.09	100	7.70	100
Chicken noodle soup	16	7.56	100	12	7.50	88	7.54	94
Vegetable beef soup	16	7.88	93	12	8.17	100	8.00	96
Corn	16	7.56	82	12	7.58	86	7.57	83
Peas	17	7.24	95	12	7.00	88	7.14	92
Tomatoes	17	7.29	100	11	7.64	100	7.43	100
Green beans	16	6.06	60	11	6.45	57	6.22	59
Lima beans	16	7.06	95	11	6.45	100	6.81	97
Class Average		7.26	91		7.36	91	7.30	91

(Continued)

APPENDIX 3.2.4-1/A (cont.) 5-IN-1

Item	First Cycle			Second Cycle			Cycles Combined	
	N	Rating	% Eaten	N	Rating	% Eaten	Rating	% Eaten
Baked Items								
Pecan roll	10	7.10	100	12	7.92	100	7.55	100
Pound cake	17	8.06	95	12	8.42	100	8.21	97
Fruitcake	16	7.00	100	12	7.33	100	7.14	100
Vanilla cookies	15	7.80	100	12	7.67	100	7.74	100
Bread	17	6.76	84	12	8.17	99	7.34	90
Class Average		7.34	89		7.90	100	7.60	94
Desserts								
Peaches	17	8.47	100	12	8.50	100	8.48	100
Pears	17	8.00	100	12	8.67	100	8.28	100
Applesauce	17	8.24	100	12	8.25	100	8.24	100
Apricots	17	8.24	100	12	8.17	100	8.21	100
Pineapple	17	8.41	100	12	8.67	100	8.52	100
Fruit cocktail	17	8.59	100	12	8.67	100	8.62	100
Class Average		8.32	100		8.47	100	8.39	100
Candy								
Choc. fudge bar	17	6.47)		11	7.45)		6.85)	
Vanilla cream bar	15	7.13)	99	11	7.73)	100	7.38)	99
Starch jelly bar	17	7.24)		12	7.50)		7.35)	
Carmel nougat bar	12	7.42)		11	8.09)		7.74)	
Choc. disc	16	7.44	100	12	6.83	100	7.18	100
Pan-coated choc.	16	7.06	100	12	7.17	100	7.11	100
Class Average		7.13	100		7.46	100	7.27	100
Beverages								
Coffee	16	6.56	70	12	6.50	97	6.54	81
Cocoa	17	8.00	99	11	8.18	100	8.07	99
Class Average		7.28	96		7.34	100	7.30	97
Accessory Foods								
Shoestring potatoes	17	6.76	89	12	7.25	100	6.97	94
Jam	17	7.65	82	12	8.00	98	7.79	89
Peanuts	16	6.69	96	12	7.50	100	7.04	98
Cheese	16	5.06	52	12	5.92	86	5.43	65
Cereal block	15	4.13	36	12	4.75	57	4.41	45
Peanut butter	16	6.44	69	11	6.64	79	6.52	73
Gum	17	6.41	---	12	6.42	---	6.41	---
Cream		---	66		---	97	---	79
Sugar		---	65		---	99	---	76
Class Average		6.16	68		6.64	88	6.37	76
Average for Ration		6.95	81		7.32	90	7.10	85

APPENDIX 3.2.4-1/A (cont.)

QUICK-SERVE MEAL
AVERAGE PREFERENCE RATING AND PERCENT EATEN
FOR EACH FOOD ITEM IN EACH CYCLE AND
COMBINED OVER BOTH CYCLES

Item	First Cycle			Second Cycle			Cycles Combined	
	N	Rating	% Eaten	N	Rating	% Eaten	Rating	% Eaten
Main Dishes								
Chili & beans	17	6.76	84	11	7.18	84	6.89	84
Bacon	17	7.52	75	11	7.91	100	7.68	84
Sliced beef & gravy	17	5.94	79	12	6.08	76	6.00	78
Spaghetti w/meat	17	5.41	66	12	6.08	84	5.69	73
Chicken & rice	17	6.88	73	12	5.58	78	6.34	74
Chicken & gravy	17	6.70	79	11	6.00	83	6.43	80
Sliced ground beef	16	6.75	80	12	6.00	96	6.43	87
Beef & potato hash	16	6.06	51	11	5.09	78	5.67	73
Class Average		6.50	74		6.24	84	6.39	78
Side Dishes								
Cabbage	16	6.25	79	12	6.75	75	6.46	77
Mashed potatoes	17	7.18	86	12	7.00	50	7.10	73
Rice	17	6.06	80	12	5.83	24	5.97	55
Lima beans	14	5.00	29	12	5.17	73	5.08	41
Oatmeal	13	6.85	63	11	7.00	100	6.92	78
Macaroni	17	6.12	83	12	5.42	95	5.83	87
Macaroni & cheese	16	5.75	93	12	6.33	100	6.00	96
Chicken & rice soup	17	7.06	83	12	6.42	87	6.79	85
Pea soup	17	6.35	66	12	6.58	80	6.45	72
Class Average		6.29	75		6.28	79	6.29	76
Baked Items								
Pecan roll	17	7.65	95	12	8.08	92	7.83	94
Fruitcake	17	6.88	100	11	7.00	95	6.93	98
Bread	17	5.88	54	12	6.58	73	6.17	62
Pound cake	17	8.24	93	12	8.50	100	8.34	96
Date pudding	16	7.31	100	12	7.08	83	7.21	94
Class Average		7.19	82		7.45	86	7.29	84

(Continued)

APPENDIX 3.2.4-1/A (cont.) QUICK-SERVE MEAL

Item	First Cycle N	First Cycle Rating	First Cycle % Eaten	Second Cycle N	Second Cycle Rating	Second Cycle % Eaten	Cycles Combined Rating	Cycles Combined % Eaten
Desserts								
Apricots	16	8.31	100	12	8.00	90	8.15	96
Fruit compote	15	6.76	65	11	7.36	100	7.06	79
Applesauce	17	7.76	92	12	7.92	92	7.83	92
Butterscotch pudding	16	8.44	100	12	8.58	100	8.50	100
Class Average		7.82	90		7.96	95	7.88	92
Candy								
Tootsie roll	17	7.88)		11	7.82)	)		
Choc. fudge bar	17	6.59)	100	11	7.00)	100)	7.22	100
Starch jelly bar	15	7.40)		12	7.25)	)		
Vanilla cream bar	17	7.00)		12	6.83)	)		
Class Average		7.22	100		7.22	100	7.22	100
Beverages								
Coffee	16	7.56	91	11	7.18	81	7.41	87
Cocoa	17	8.65	100	12	8.67	100	8.66	100
Milk	16	6.75	62	11	6.54	96	6.67	75
Orange juice	15	8.07	69	12	8.08	100	8.07	82
Grapefruit juice	12	7.33	67	11	6.91	100	7.13	82
Tea	4	8.25	74	9	7.44	36	7.69	64
Class Average		7.77	73		7.47	97	7.60	83
Accessory Foods								
Margarine	16	6.94	47	11	7.00	51	6.96	49
Jam or Jelly	15	8.07	73	11	7.82	98	7.96	83
Cereal bar	15	4.13	22	11	5.00	63	4.50	38
Peanut butter	15	6.40	50	11	6.18	37	6.31	44
Sugar		—	58		—	66	—	61
Potato sticks		—	79		—	86	—	72
Cream		—	51		—	57	—	55
Class Average		6.38	52		6.50	60	6.43	55
Average for Ration		6.91	77		6.87	84	6.89	80

MEAL, COMBAT, INDIVIDUAL
AVERAGE PREFERENCE RATING AND PERCENT EATEN
FOR EACH FOOD ITEM IN EACH CYCLE AND COMBINED OVER BOTH CYCLES

Item	First Cycle			Second Cycle			Cycles Combined	
	N	Rating	% Eaten	N	Rating	% Eaten	Rating	% Eaten
Main Dishes								
Beans w/franks	18	7.61	99	12	7.58	100	7.60	100
Ham & eggs	18	6.76	83	12	7.42	96	6.90	88
Ham & potatoes	17	5.70	70	12	6.17	79	5.90	74
Pork steaks	17	4.53	64	12	5.92	100	5.10	78
Turkey loaf	17	6.35	72	12	5.75	83	6.10	77
Beef & peas	17	5.88	74	12	6.08	96	5.97	84
Spiced beef	18	5.67	94	12	6.67	100	6.07	97
Beef steaks	18	5.22	71	12	5.92	73	5.50	72
Fried ham	17	5.53	82	12	6.67	96	6.00	78
Tuna & noodles	18	6.33	86	12	7.50	100	6.80	92
Chicken	18	7.00	98	12	6.92	100	6.97	99
Class Average		6.05	80		6.60	92	6.26	85
Baked Items								
Pound cake	18	8.33	93	12	8.33	100	8.33	96
Crackers	18	6.61	67	12	7.17	88	6.67	76
Pecan roll	17	7.82	88	12	8.17	100	7.97	93
Bread	17	6.29	54	12	7.50	99	6.79	74
Vanilla cookie	18	8.11)		12	7.75)		7.97)	93
Choc. chip cookie	12	7.75)	87	12	7.25)	100	7.50)	
Class Average		7.48	78		7.69	96	7.54	86
Desserts								
Apricots	17	8.41	97	12	7.67	100	8.10	98
Pears	16	8.62	100	12	8.58	100	8.61	100
Pineapple	18	8.22	89	12	8.58	100	8.37	93
Peaches	17	8.72	86	12	8.42	100	8.60	92
Class Average		8.49	92		8.31	100	8.42	96
Candy								
Coconut disc	16	7.18)		12	7.42)		7.28)	
Choc. fudge disc	18	7.11)	80	11	7.64)	99	7.31)	88
Vanilla cream disc	16	7.75)		11	7.72)		7.74)	
Sweet choc. disc	17	7.82	97	12	7.58	100	7.70	98
Class Average		7.46	86		7.59	99	7.51	91

(Continued)

APPENDIX 3.2.4-1/A (cont.) MEAL, COMBAT, INDIVIDUAL

Item	First Cycle			Second Cycle			Cycles Combined	
	N	Rating	% Eaten	N	Rating	% Eaten	Rating	% Eaten
Beverages								
Coffee	18	6.94	78	12	6.67	67	6.83	78
Cocoa	16	7.75	81	12	7.42	100	7.61	90
Class Average		7.34	81		7.04	99	7.22	89
Accessory Foods								
Peanut butter	17	6.65	66	12	6.75	95	6.69	78
Jam	17	7.65	59	12	7.58	90	7.62	72
Gum	17	6.59	-	12	6.58	-	6.59	-
Cream		--	57		--	82	--	68
Sugar		--	67		--	92	--	78
Class Average		6.96	62		6.97	91	6.96	75
Average for Ration		7.01	77		7.24	95	7.10	85

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